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AUSTRALIAN COASTAL EXPLORATION IN ANTARCTICA

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ON 27 DECEMBER 1955, an Australian National Antarctic Research Expedition sailed from Melbourne, under the leadership of the writer, in the ship *Kista Dan* (Master: Captain H. C. Petersen). The objects of the expedition were to relieve the Australian scientific station at Mawson in Mac-Robertson Land and to carry out exploration along the coast of Australian Antarctic Territory, particularly in Wilkes Land. The expedition was equipped with a Beaver aircraft, operated by a Flight of the Royal Australian Air Force commanded by Squadron Leader Douglas Leckie, A.F.C., and the ship was fitted with a Kelvin Hughes echo sounder capable of recording depths to approximately 2000 metres.

Wilkes Land stretches from approximately the eastern edge of the Shackleton Ice Shelf to the western boundary of Terre Adélie. No ship had previously sailed close enough to the shore to land a party in this region. The only visits ever made were those in which men from the United States Operations "Highjump" and "Windmill" were landed from the air in the Windmill Islands and Hordern Hills areas by aircraft operating from ships standing well out to sea beyond the pack ice belt. These landings were all to the west of long. 111° E.

Aerial photographs taken during "Operation Highjump" cover most of this coast and the United States authorities in 1955 produced a working map of the coast based on these photographs. However, lack of astrofixes in the unvisited region prevented the accurate location of features in this section.

Proceeding south-south-west from Melbourne, the *Kista Dan* encountered pack ice on January 5 at the position lat. 64° 55′ S., long. 136° 04′ E. and began to push through, while the RAAF Flight prepared the Beaver aircraft for flight. Soundings were obtained with a depth of 404 metres at noon in position lat. 64° 58′ S., long. 136° 12′ E. At a little after 1300 hours a large, quiet pool was found amongst the pack ice and here the aircraft, mounted on floats, was put up for a reconnaissance flight, with Leckie and Law on board. The day was perfect and visibility excellent. To the south, fast ice prevented any approach to the coast but further west there were open leads all the way into Davis Bay.

Near the southern extremity of Davis Bay we found a small rocky islet—a desolate piece of rock breaking the surface of the blue sea very close to the vertical ice cliffs of the mainland. It had been named Lewis Islet by "Operation Highjump" from aerial photographs and, after close examination, we decided that a landing on it would not prove difficult. Beyond, we flew over the Continental ice sheet, which rose rapidly in the first 7 miles to an altitude of 2500 feet. No other exposed rock

features were sighted in the vicinity, although several small rocky islets were seen in Davis Bay which were covered with a thick mantle of ice. The coast consisted of vertical ice cliffs, about 100 feet in height, and no inland nunataks or mountains could be seen from the aircraft flying at 10,000 feet. The direction of the prevailing wind, as shown by the *sastrugi* on the Continent, was east.

A few miles to the east of Lewis Islet an accumulation of domed icebergs, apparently grounded, extended for 20–30 miles out to sea. For the first few miles they were cemented closely together by semi-permanent bay ice, which wind-drifted snow had built up almost to the tops of their vertical sides. The bergs became more widely distributed further from the coast, where the bay ice gave way first to fast ice and then to open water. Out in the bay two types of icebergs could be seen—domed bergs from the iceberg tongue and flat-topped tabular bergs broken from other parts of the coast. It would appear that bergs from the iceberg tongue take many years to make their way north to deep water.

The iceberg tongue is not produced by a glacier, for there is no pattern of crevassing or ice streams inland to differentiate this part of the Continental ice sheet from other parts along the coast. Apparently the ice sheet, moving uniformly shorewards, is disrupted in the area by passing over knobby coastal eminences (hills) in the underlying rock which is probably well below sea level. The disintegration of the ice sheet takes place in a coastal area 3 or 4 miles wide and 10 or 15 miles long. The domed shape of most of the resulting bergs would appear to be the result, first, of the method of disruption, which humps the ice as it passes over the hills, and secondly, to the accumulation of snow on the surfaces of the icebergs during the many years which elapse before they move sufficiently far north to reach deep water and float away. By contrast there was a long, narrow, tabular berg (about 2 miles long) which had recently broken from the ice coast a few miles west of Lewis Islet, where the water was apparently deep enough for it to float out without obstruction.

The aircraft returned after a flight of three and a half hours and was hoisted on deck; the Captain was informed of the best course to follow and the ship then proceeded, first west and north-west through very heavy old floes, then south-south-west in open water with the iceberg tongue on its port beam. Soundings taken showed that the edge of the Continental Shelf was crossed twice, outwards at lat. 64° 55′ S., long. 135° 35′ E. and inwards at lat. 64° 55′ S., long. 134° 32′ E. At about 1800 hours on January 6 we ran into open pack ice and could see the creamy slopes of the Antarctic Continent ahead. On our starboard side lay a giant iceberg which we estimated extended for 15–20 miles. We had some difficulty in finding Lewis Islet in the dusk in the wide bay cluttered with icebergs, but at 2330 hours it showed up and the ship anchored at 0130 next morning.

Saturday January 7 dawned windy and grey, with low clouds. A scientific party was landed by motor-boat on Lewis Islet at 0830 hours and a variety of work was soon proceeding. Surveyor Kirkby commenced sun observations, geophysicist McGregor carried out absolute magnetic determinations and gravity observations, and Bunt and Dowie made notes concerning the geology of the islet and the penguins and petrels nesting there. In the afternoon the clouds cleared and Clemence and Leckie made a photographic flight, first from Lewis Islet to Cap Bickerton (in Terre Adélie) and then westward as far as Porpoise Bay. While the aircraft was to the west, a large C-54 United States aircraft flew over Davis Bay at a great height, turned, and went back eastwards. It showed no sign of having seen us.

Lewis Islet is a sanctuary for thousands of birds. A census showed there were 1840 breeding pairs of Adélie penguins, grouped in separate colonies of between ten and forty pairs according to the available area of snow-free rock. Some adults were sitting on eggs, others were tending their downy chicks. Silver-grey petrels were hatching their eggs, as also were skuas and Wilson storm petrels, but the cape pigeons had apparently not yet laid. Antarctic petrels were common and their chicks were just beginning to hatch. Lichens were rare and no mosses were found, but the common green algae usually found around penguin rockeries was present. The rock of which the islet was composed was a coarse-grained granitic gneiss through which ran dykes of finer-grained rock. A few erratics were seen, and there was a lot of quartz amongst the granite, but geological variety was lacking.

During the afternoon Bewsher, Ayres and I crossed by boat from Lewis Islet to the mainland and climbed the ice cliff to the gently sloping névé surface above. We walked about a mile inland and took a number of photographs. The view from the ice sheet was magnificent. To east and to west stretched the coastal ice cliffs of the Antarctic Continent, 100–150 feet high and as sheer as though carved with a knife. The blue sea, the bay full of icebergs, the warm sun, the brown rocky islet and, beyond, the red *Kista Dan* combined to form a colour picture I shall never forget.

Work continued ashore on January 8 and a further photographic flight was made (by Seaton and Leckie) to cover the shores of Porpoise Bay and extend to Cape Goodenough. Black clouds, a lowering sky to the north and a freshening north-west wind which arose while the aircraft was away caused some concern at the ship, but the plane returned safely after a five-and-a-half-hour flight. Unfortunately some of the photographing runs were spoilt by cloud. The programme on Lewis Islet was completed during the afternoon with tape recordings of the calls of the nesting sea birds.

Monday January 9 was a raw, misty day with poor visibility and we sailed from Lewis Islet at 0425 hours. We began by following the coast and plotting it with the aid of radar, but at 1000 hours a line of icebergs and fast ice forced us northwards again towards the open sea. The edge of the Continental Shelf was crossed at lat. 64° 38′ S., long. 132° 03′ E. I wished to sail westward and approach the coast again in the vicinity of Cape Southard, from which we could fly back to continue our aerial photography from the point where we had left off. Accordingly, we proceeded north to lat. 64° S., then sailed westwards until near long. 120° E., where we again turned south. At 0400 on Wednesday, January 11, we stopped in a small bay surrounded by pack and hoisted out the aircraft. A reconnaissance flight to the south (by Leckie and Law) proved most interesting. To the east we could see a great iceberg tongue, composed of glacier bergs and domed types, which extended north for about 50 miles from Cape Southard. The bergs appeared to be stranded on a bank and again the spaces between them were choked up with bay ice and fast ice. The tongue appeared to be only 5–10 miles wide, and open water and fast ice could be seen on the far side. It occurred to me that this might be what Wilkes saw in this region and marked as the Continent. Certainly from a ship a few miles off, the vertical ice cliffs of these overlapping bergs, with apparent bays and indentations giving it an irregular appearance, would be indistinguishable from ice cliffs of the Continental coast. About 20 miles west of Cape Southard we crossed the coast, which here appeared to consist partly of ice shelf and partly of smashed Continental ice and bay ice—a fantastic jumble of confused ice through which in certain places brown rotten ice and sea water showed.

We turned east and 5 miles on discovered several small outcrops of rock set amongst solid bay ice about 1 mile south of the coast. These were apparently the Henry Islets of the United States working map but they were inaccessible except by helicopter. Ten miles further east again we saw Chick Islet, a small exposed area of high rock joined to the nearby ice shelf by projecting bay ice at a lower level. It, too, appeared to be inaccessible from the sea. We flew on, with aerial cameras ticking, for another ten minutes before turning about and flying westward. We flew again over Chick Islet and Henry Islets and continued for about 30 miles to a distinctive iceberg tongue where we turned out to sea. From here we searched out the best sea route through the pack ice back to the *Kista Dan* and carefully plotted times and courses to enable us to map the track. We landed beside the *Kista Dan* after a four-and-a-half-hour flight.

At noon the ship proceeded in an attempt to follow the course the flight had indicated. Our flight had shown that along this coast no rock features of an easily accessible nature existed; nevertheless it was thought worth-while making an attempt to approach this coast, for even if no land astrofix could be obtained, a reasonably good ship's fix might be made opposite the rock exposures and tied in by aerial photographs, and extensive photographs of the coast beyond this point could be made during further flights. Within 5 miles we found ourselves in heavy pack and thereafter never picked up the reconnoitred path. We stopped in the ice at 2200 hours and resumed our slow progress next morning. The ice was composed of very thick, old floes but in the afternoon conditions improved and we made better progress. Finally we ran into a long, open pool lying south-west which was closed at its far end by half a mile of heavy consolidated pack jammed against a large 7-mile iceberg. Beyond this our flight had shown there was comparatively open water. When the ship attempted to break into the ice at the end of the pool, it was found that it was under heavy pressure and any gap opened by the charge of the ship immediately closed up when the ship backed for its next charge. The Captain considered it too dangerous to work heavy ice in this condition and the ship waited in the open pool for conditions to improve.

For three and a half days progress was halted and the ship moved only a mile or two up and down the open lead to avoid closing pressure ice, or to probe in at other places. Much of the ice was unbroken winter ice, heavily hummocked, which would have tested a large icebreaker. On Friday January 13 we had the misfortune to damage irreparably the floats of the Beaver aircraft. In view of the impasse we had reached I had decided on another aerial reconnaissance, but when the 'plane was being hoisted the lifting sling broke and it fell back onto the deck. Fortunately the floats were at the time only about 2 feet clear of the cradles, otherwise the aircraft—and possibly some of the men—would have been seriously damaged. This was a serious blow to our plans, as our coastal flights in future would depend upon our finding ice floes large enough to act as airfields for an aeroplane mounted on skis. That evening the Beaver was hoisted out onto a floe, where the RAAF Flight worked until after midnight to change it over to skis.

On Monday January 16 the pressure in the surrounding ice had eased somewhat but there was little improvement in the general distribution of the ice and so the ship began to work its way north-westward. At 1530 we had the good fortune to find a piece of detached bay ice more than 1 mile in diameter and we seized the opportunity to try out the aircraft on skis. As this was the first experience any of the pilots had had of a take-off on skis, and as we were uncertain how the skis would run on this type of snow surface, Leckie carried out a trial flight. Everything

went smoothly so a reconnaissance flight was carried out (by Leckie and Law) at 1920 hours to determine finally what chances existed for approaching the coast in this sector.

To our disappointment we found that conditions had greatly changed since our flight of only a few days earlier, and ice conditions even south of the large berg were unfavourable. We could see no way through to the coast, and snow showers and low cloud prevented our searching further. Our next objective was to find a way out of the ice and, before landing, we spied a reasonable route to the north-east. After returning to the ship I informed the Captain that I had decided to abandon this part of the coast and to press on 300 miles further west. Accordingly we moved off from our icefloe airfield towards the open ocean, which we reached at 1430 hours next day. We proceeded in a westerly direction all Tuesday in open water.

On Wednesday January 18 we turned south again towards Vincennes Bay. At noon we entered the ice but the pack was reasonably open and we made good progress. At 1630 the plateau was visible and we crossed the Continental Shelf in position lat. 65° 17′ S., long. 110° 47′ E. On our starboard side was a large accumulation of bergs. The ice here was quite different from that at long. 119° E.—smaller, flatter floes with no unbroken winter fast ice. The creamy Continental slopes became clearer until rock outcrops were visible at the coast and lines of moraine debris at a level of about 1000 feet running parallel with it. The outcrops turned out to be islets of the Balaena group and the *Kista Dan* tied up overnight to a large floe about 2 miles offshore.

Early next morning the ship crept in on the western side of the largest islet and anchored at 0800 hours. Our technique of "hit-and-run" landings was now well established and by 0900 the men were ashore making observations. A cairn was erected on the highest point of the islet and a message was left beneath it. (Later both the Russian and the United States expeditions were to visit this islet and find the message.) The weather was delightful—no wind, a thin overcast through which the sun shone feebly, and temperatures only a little below freezing. From the islet the scene was unforgettable—the smooth sea, sprinkled with floes, bergy bits and icebergs; the scarlet ship motionless against the sheer ice cliffs of the Continent whose slopes rose steeply inland; the warm, chocolate-brown rock; the curious penguins and, above all, the placid peace and calm which only a tranquil day in the ice can give. The squeaks of Adélies carried clearly from far-off floes and the little chugging motorboat cut through the floating chips of ice towards the shore, leaving a fantail of spreading ripples. Off the northern edge of the islet an old bergy bit, newly-capsized and glazed with fresh ice, gleamed a burnished blue in the sunlight.

Our islet, which we named "Thompson Islet" after my lieutenant for the voyage, was the largest one of the Balaena group, which altogether comprises six islets. The country rock was principally grey micaceous granite of fairly fine grain. Quartz intrusions occurred as conspicuous veins and frequently carried large phenocrysts of biotite and possibly augite and hornblende. Gravel and sandy soils were plentiful. However, there were fewer birds than on Lewis Islet. Skuas, snow petrels (whose chickens had just hatched), Wilson storm petrels and Adélie penguins were the only nesting species. Scarlet, grey and black lichens grew on the rocks and there were the usual green algae growing in the water runnels beneath the penguin rookeries. We completed our scientific observations at about 1500 hours and sailed at 1620. There was some excitement when, on rounding the northern side of the

islet, the sea floor rose steeply within a few yards from a depth of 60 metres to 8 metres; however the ship was proceeding very cautiously and was able to back off and choose another route.

Our immediate desire was to find an ice floe suitable for use as an airfield, so with this in mind we sailed eastward. The Captain had spied from the crow's nest an ice floe which looked promising and at 2000 hours we tied up beside it. The aircraft was soon hoisted out and Clemence and Seaton carried out practice take-offs and landings. On the first of these we had a bad fright, for the plane roared across the ice floe, showing no signs of lifting, and finally staggered into the air only 50 feet short of the edge.

Friday January 20 dawned fine and a photo run (by Seaton and Clemence) was carried out eastward with the Totten Glacier as its objective. Unfortunately cloud precluded photography beyond Cape Poinsett so the plane returned and proceeded to photograph the Windmill Islands to the south-east. When it returned we sailed at 1530 hours for the Windmill Islands. Between us and Vincennes Bay lay a great accumulation of icebergs, stranded on a bank extending north from just west of the Balaena Islets. We were reluctant to sail 30 miles north to round this bank and decided to try to cross it. The Captain, navigating from the crow's nest, took the ship in a southerly direction along the eastern fringe of the icebergs looking for a gap. At about 2200 he turned westwards and very skilfully edged the ship across the bank, the minimum depth registered on the echo sounder being 12 metres. Standing beside him in the crow's nest, in the dim twilight, I was greatly impressed by Captain Petersen's ability in interpreting the tilt and height of grounded bergy bits to determine the best channels through which to steer, for often small stranded ice blocks lay only 15 yards to one side of the ship. I resolved to call the bank "Petersen Bank" as a tribute to his skill. Shortly after midnight we anchored in a pool of completely ice-free water, so shallow that no bergy bit could drift over it.

Next morning we felt our way gradually across the rest of the bank into deeper water, relieved to have negotiated the crossing safely. To the south, about 2 miles away, lay a group of islets which I named "Donovan Islets," in honour of the administrative officer of the Antarctic Division. These attracted me because of the extensive Adélie rookeries which could be seen covering their slopes, but the water was very shallow and the Captain was loath to approach them closely, so I decided instead to land on a group of islets further to the west, where the water appeared deep enough to permit a close approach.

We anchored at 0945 about half a mile to the north of the largest of three islets, which I named "Nelly Islet" because of the giant petrels ("nellies") which nested on it. I decided to leave six men here to carry out scientific work while the rest of us proceeded in the *Kista Dan* to visit the Windmill Islands to the south-south-east. Two ferry trips by the motorboat put our men and their camping equipment ashore and gave me a chance to photograph the islet and its remarkable bird life. Those left ashore were Bewsher, Bunt, Dowie, Kirkby, McGregor and Ayres. There were four main giant petrel rookeries, totalling about 250 nests, on the northern ridge of the islet. This is probably the most southerly record of the nesting of these birds. Some were very dark and some dark with light-coloured heads, but there were no "white phase" nellies. Most of these had chicks some weeks old. Other birds nesting on the islet included cape pigeons, silver-grey petrels, skuas, snow petrels, Wilson storm petrels, and Adélie penguins. The islet's principal rocks consisted of finely-banded medium-grained gneisses. Layers of dominantly light-coloured minerals (quartz and felspar) alternated with others of biotite and magnetite. The

entire series was tilted almost vertically, the strike running south-east and north-west. Where we first landed on the northern side the granite schists had been deformed by pressure into whorl patterns. The northern ridge was practically a scree slope of broken, shale-like, thin plates lying almost vertically against one another. Erratics were common—some very large—mostly consisting of varieties of pink or red granite. Lichens were rare but algal growth was luxuriant in sheltered moist areas. In a cove on the eastern side we found molluscs, medusae and small crustaceans; and below ice level there were quantities of small kelp and a green, filamentous seaweed. From the top of "Nelly Islet" I examined the Windmill Islands through binoculars. They appeared to consist of two distinct types of rock—one lot dark, almost black, and the other light pinkish-brown. This was later confirmed from the aircraft.

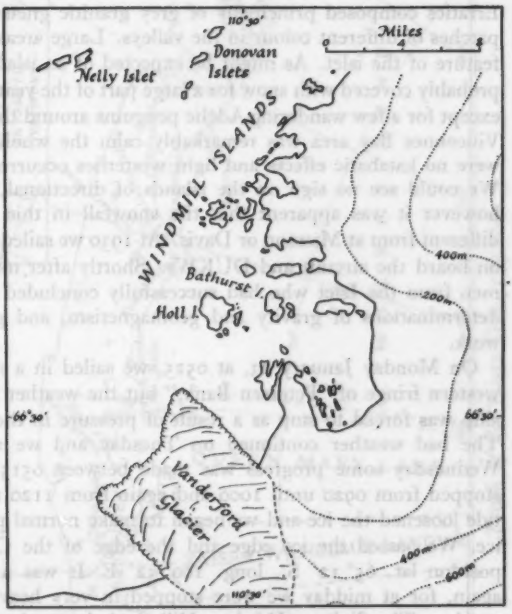


Fig. 2. Windmill Islands area

At 1530 the *Kista Dan* proceeded south and at 2025 hours we found a large ice floe, suitable for an airfield, 2½ miles west of Holl Island (Windmill Islands), and tied up alongside. This was indeed most fortunate for such floes are quite rare and this one ensured that we should be able to extend our coastal photography to the west. The aircraft was hoisted out and men worked until nearly midnight preparing it for flight. On Sunday January 22, at 0500, the aircraft took off (with Leckie and Law), but the Windmill Islands were covered by cloud. However, we photographed "Donovan Islets" and "Nelly Islet" and carried out scintillometer runs over all the exposed rock in Vincennes Bay. At 0930, after refuelling, a photographic flight commenced (Clemence and Seaton) which extended as far west as the Hordern Hills. After this, as the clouds had cleared from the Windmill Islands, these were photographed on another flight (by Seaton and Schlossbach).

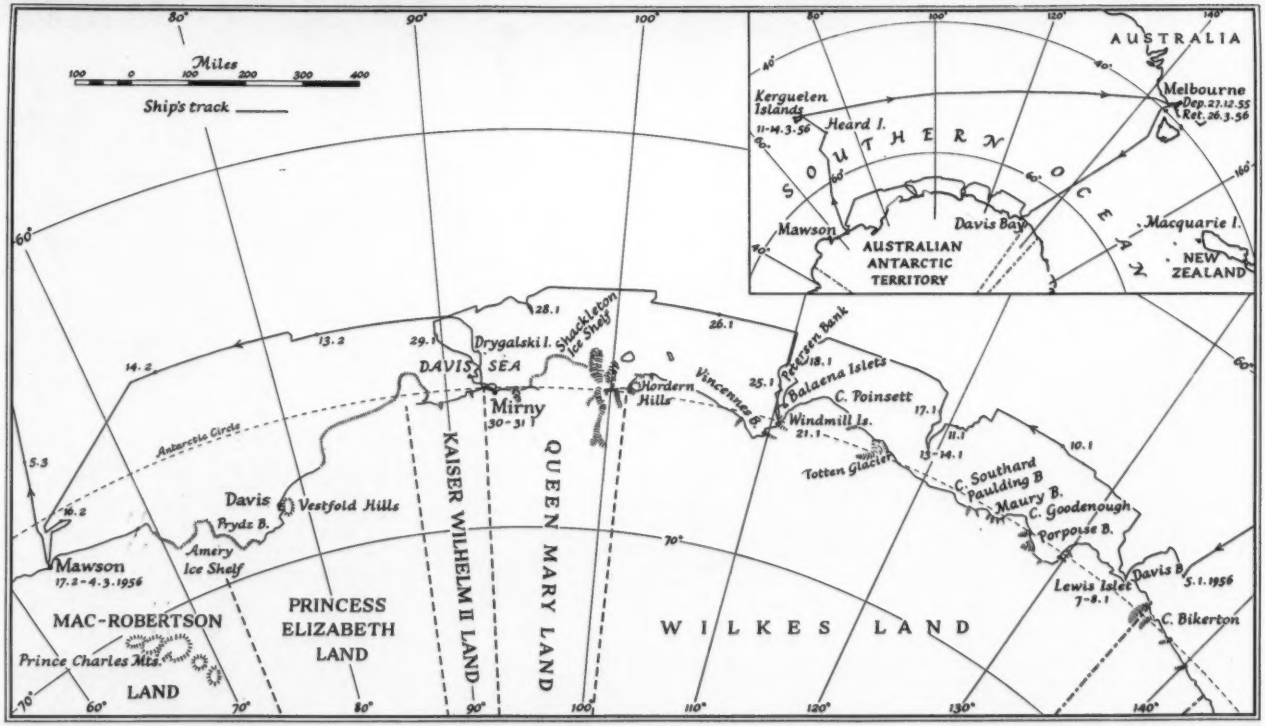
Meantime, at 1040 hours, I had left the ship with seven others in two DUKWs to visit one of the pale pinkish-brown islets. We cruised in perfect weather about 6 miles by sea in the DUKWs, the ice floes and bergy bits glinting and flashing in the blue water. Penguins swam or porpoised ahead and Wilson storm petrels flitted like swallows around us. High up on the sheer cliffs of Holl Island the silver-grey petrels wheeled around their nests. Then, to our surprise and theirs, two Adélie penguins shot out of the water onto the deck of a moving DUKW, stared

in startled fashion at us, emitted a few squawks, and dived back into the sea. We landed on an island which I named "Bathurst Island" after the officer in charge of DUKWs (Lieutenant William Bathurst) and spent an hour ashore collecting rock specimens. A cairn was erected on a high point at the southern end and a round of photographs was taken.

The country rock consisted of coarse-grained pink and dull brown granitic gneisses composed dominantly of quartz, felspar and biotite. Where weathered by ice and melt-water the ridges at a distance looked like waterworn sandstone. Erratics composed principally of grey granitic gneisses, rich in quartz, provided patches of different colour in the valleys. Large areas of pink country rock were a feature of the islet. As might be expected of an island close to the mainland and probably covered with snow for a large part of the year there was no sign of bird life except for a few wandering Adélie penguins around the shores. The weather in the Vincennes Bay area was remarkably calm the whole time we were there. There were no katabatic effects and light westerlies occurred as often as light easterlies. We could see no sign on the islands of directional patterns in the snow drifts; however it was apparent that the snowfall in this region is fairly high—quite different from at Mawson or Davis. At 1930 we sailed for "Nelly Islet" after taking on board the aircraft and DUKWs. Shortly after midnight we picked up the six men from the Islet who had successfully concluded observations for an astrofix, determinations of gravity and geomagnetism, and geological and ornithological work.

On Monday January 23, at 0525, we sailed in a northerly direction along the western fringe of "Petersen Bank," but the weather deteriorated and at 1425 the ship was forced to stop as a result of pressure in the pack ice and bad visibility. The bad weather continued on Tuesday and we remained stationary, but on Wednesday some progress was made between 0515 and 0920 hours. The ship stopped from 0920 until 1000 and again from 1120 until 1554 when a change in tide loosened the ice and we began to make normal progress through 6/8ths pack ice. We passed the ice edge and the edge of the Continental Shelf at 1930 in position lat. 65° 12′ S., long. 109° 52′ E. It was a relief to be in open water again, for at midday we were stopped in very heavy ice with little prospect of moving. The flight to Hordern Hills had shown that there was no chance of our ship penetrating the pack ice and fast ice to reach the coast anywhere between the Shackleton Ice Shelf and the Windmill Islands, so I asked the Captain to proceed to the Davis Sea and attempt to push through to the Russian station at Mirny. I advised the leader of the Russian expedition, Dr. M. Somov, of our proposed visit and asked him for advice concerning ice conditions in his vicinity. He replied that he would be glad to see us and offered to carry out an ice reconnaissance by plane should we require it.

On Saturday January 28 our first attempt to proceed southwards just west of the Shackleton Ice Shelf was blocked by heavy ice to the east and south. Here we met the Continental Shelf in position lat. 64° 40′ S., long. 95° 10′ E. We therefore withdrew to the north and west to the centre of the top of the Davis Sea. At 2130, in bad visibility, a Russian aircraft flying very low came out and made a reconnaissance of the ice between our ship and the coast. On Sunday, following advice received as a result of this flight, we pushed on through reasonably easy ice to Drygalski Island and on Monday at 1050 hours we anchored off Mirny. The Russians entertained us hospitably, and valuable conversations concerning our respective scientific programmes were held. Dr. M. Somov, the leader of the



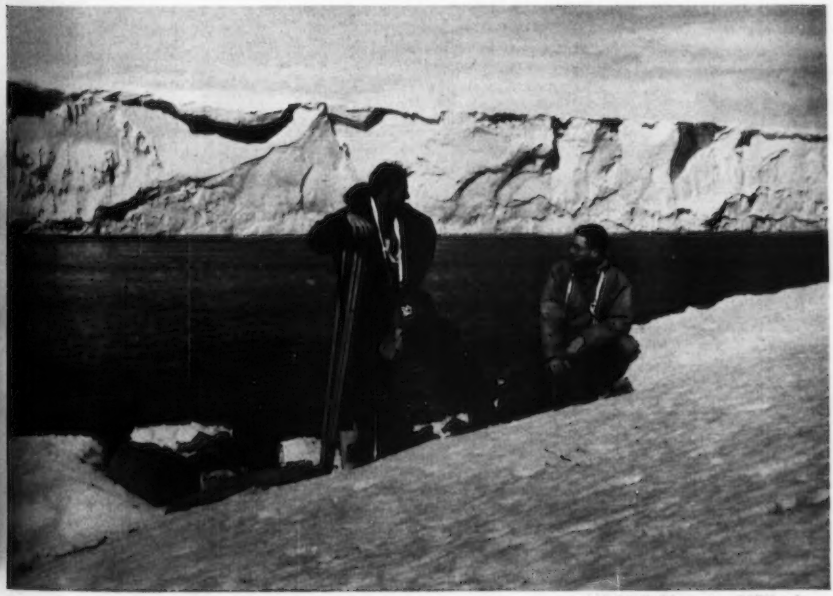
Track of the Kista Dan, *1955–6*

ANARE Photo by Philip

Kista Dan, *near Windmill Islands, coast of Wilkes Land, January 1956*

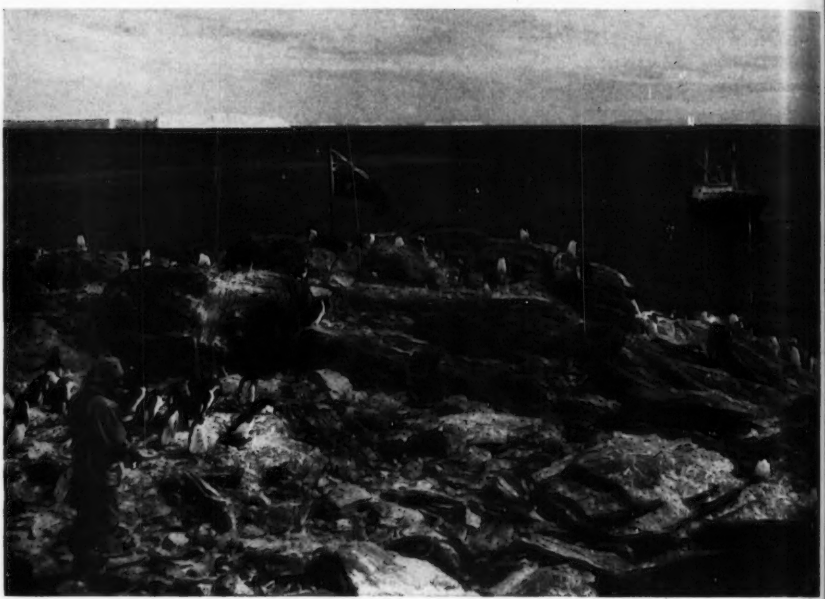
ANARE Photo by Phillip Law

ANARE camp on Nelly Islet; with Continent in background



ANARE Photo by Plillip Law

Syd Kirby (left) and Peter McGregor, Lewis Islet; mainland cliffs in background



ANARE Photo by Phillip Law

Lewis Islet, January 1956

ANARE Photo by Phillip Law

Silver grey petrels nesting on Nelly Islet, January 1956

USSR 1956 Expedition conducted us on a tour of the Station and Captain I. Man, master of the *Ob* and Captain A. Vietrov, master of the *Lena*, showed us over their ships. On the Tuesday a photographic flight was carried out (by Seaton and Law) from Mirny eastwards to the Hordern Hills, the fast ice near Mirny being used as an airfield. This flight linked up with that by Clemence and Seaton from the Windmill Islands. Unfortunately, storm and cloud marred the final stages of our flight over the Hordern Hills.

On Wednesday February 1 the weather deteriorated and, as no further aerial photography was possible, I decided to leave Mirny and proceed to Prydz Bay and the Vestfold Hills. Accordingly we sailed at 0745 hours. The wind rose rapidly and by 1100 was blowing at 50 m.p.h. from the east. Captain Petersen preferred to shelter in the pack than to stay in the open water and so, at 1500 hours, we ran into loose pack ice and stopped at 1525 with the ship's bows pointing east, hard up against a high, flat ice floe off which the drift plumed and swirled. By 1800 the ice, under the action of the gale, had hemmed us in fast and the barometer had dropped to 976 mb. Our position was about lat. 66° 06′ S., long. 91° 26′ E. The ice appeared to be banked up by the wind against the eastern side of the West Ice Shelf and it was not until Sunday, when the wind had died down, that the ship was able to move. Recalling that it was not far from here that Professor Erich von Drygalski had his ship *Gauss* iced in for a year did not help to reassure us.

On Sunday morning the Captain spent two and a half hours backing and charging in tight ice in order to turn the ship. Another three hours of work gained us only 100 yards in distance and the attempt was abandoned. Open water could be seen beyond the ice edge only 1½ miles away but there seemed little prospect of our reaching it, for after lunch the barometer dropped and the wind rose again. Monday was a bad day and we sat tight. A 40-knot wind drove fine drift snow horizontally across the decks and the Beaver aircraft strained and shuddered under its moorings. Tuesday and Wednesday we remained stationary; an atmosphere of gloom descended over the ship as the inaction began to tell on the men, and the prospects of further coastal exploration receded further and further as our precious time continued to run out. On Thursday the wind dropped but the weather remained dull and grey. At 0430 the engines started up and the Captain began backing and charging against the ice. By midday we had made about 100 yards and by 2200 our progress totalled nearly half a mile, so we retired in a more optimistic frame of mind. Friday, however, brought further difficulties. After two hours of slow progress by backing and charging the ship wedged up on broken ice and all attempts to free it failed. I obtained the Captain's permission to use explosive under the bows and the ship slid back into the water. We made 60 yards in the next four hours but when within only about half a mile of the open sea we ran into a difficult spot where the only path lay between two large heavy blocks of ice, as high as the bows of the ship, separated by 40 feet of tightly packed floes. At 1600 hours, when attempting to negotiate this gap, we became badly wedged halfway through. This time several attempts to free the ship using explosive failed. All men therefore climbed out onto the ice and spent two hours digging the ice away from under the starboard side of the ship. When the pressure had been decreased by this means the crew was able to winch the ship astern by hauling on two ice anchors. There, halfway between the ice blocks, we remained overnight. Next morning, Saturday, we again started badly. After successfully passing through the gap the ship swung a little to port and the large block on the starboard side of the gap drifted across directly behind the *Kista Dan*. There was then no room for the ship to back for

its next charge. However, with the aid of an ice anchor, the crew was able to winch the bergy bit about 20 feet to one side and at 0700 the Captain started to work the ship again with about a dozen yards of freedom.

Our efforts seemed quite futile against the power of the ice, yet we had no choice but to push on with our feeble attacks in the hope that the sum total over a period of hours, or days, would bring us through. Each time we backed we were brought up hard with a shuddering jar by the heavy hump of ice astern; each time we charged we advanced 3 to 5 feet before the compressed ice brought us to rest. The broken ice withdrew reluctantly each time the ship surged forward, then slid comfortably back into place as we retreated to prepare for the next charge. The two greatest frustrations of the voyage were occasioned by small widths of ice—at long. 119° E. it was only a few hundred yards of pressure ice near the large iceberg which blocked us from the coast, and here in the Davis Sea it was half a mile!

By 0900 we were making slow but steady progress again. The icebreaking involved pulverizing a lane *twice* the width of the ship, so that water would be available at the side of the vessel into which the broken floes could be pushed. This involved repeated charging in several directions for each forward gain in distance. However, this technique was gradually paying dividends. The last 400 yards to the open sea proved to be unexpectedly difficult. Under the action of the swell, this area had loosened considerably and the floes had been pulverized to brash ice of the consistency of concrete. When the ship charged, the friction of this ice on the hull brought her to a stop in her own length; when she backed away the ice closed in again in front so that it was not possible to go well back for a more powerful charge. Back and forth we went, time and time again, without any apparent gain. After 1600 hours the tide changed, the wind, from dead ahead, increased and the ice pressed more closely. For a long time our charging, which now had been reduced to a distance of 10 yards, seemed to be without avail; but gradually we won a few yards, and for every yard gained, the situation became easier. Finally, within 200 yards of the open sea, the ship suddenly began to gather way and, in a burst of speed, charged out through the rather terrifying confusion of the ice edge, where cottage-sized growlers and old heavy floes heaved and wallowed in the swell amidst a welter of brash and spray. At 2000 hours we were free and proceeding north in open water. The time lost precluded any hope of a visit to Prydz Bay or further aerial photography. There was barely time for us to visit Mawson and carry out the main objective of our voyage—the relief of the ANARE station. We therefore headed westward towards the men who, after twelve months' solitude, had been anxiously watching our battle with the ice and wondering whether they were to be condemned to a second year in the Antarctic.

The *Kista Dan* (Captain K. Hindberg) returned to Melbourne on 11 December 1956 after a successful relief voyage to Macquarie Island, which was led by the Administrative Officer of the Antarctic Division, Jerry Donovan. By the afternoon of December 17 loading was finished and the ship sailed at 1615 hours. We headed on a great circle route for Mawson and made slow progress in heavy weather for the first eight days. Thereafter we had exceptionally calm weather and reached the pack ice on 3 January 1957 in position lat. 65° 31′ S., long. 65° 41′ E. Reconnaissance flights during the next two days showed that, although fast ice 40 miles wide adhered to the coast off Mawson, the water in Prydz Bay, 300 miles to the east, was open. I therefore decided to leave the relief of the Mawson Station until later and

proceed to Prydz Bay to seek a site for the projected new station in the Vestfold Hills.

On 9 January 1957 the *Kista Dan* reached a point about 10 miles off the West Ice Shelf and that evening a further flight confirmed that the approaches to the Vestfold Hills were open. The next three days were spent in an unceasing search of the rocky, ice-free coast for a suitable site for the new station. A landing on the continent at the southern edge of the Rauer Islets proved the area to be unsuitable and a number of flights and boat excursions failed to discover a good spot until 0200 hours on January 12, when a landing was made on a small, sandy beach which offered reasonable prospects.

A small pebbly terrace on a rise above the beach provided a site for huts which was clear of moraine boulders and, by careful navigation, the Captain was able to

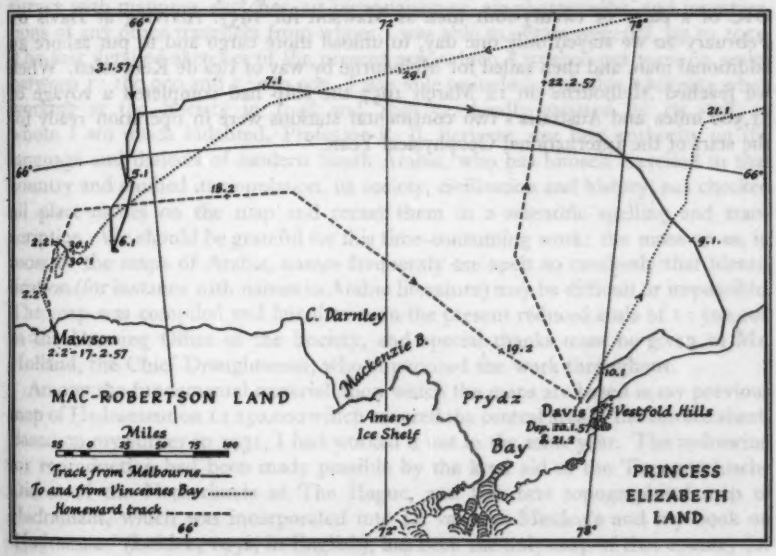


Fig. 3. Track of the Kista Dan, *1957*

bring the ship to within half a mile of the shore. I decided that the location would satisfy our requirements although the absence of water, snow or ice for drinking caused me some concern. Unloading proceeded rapidly and the men cleared a rough track for the Army DUKWS up the steep slope to the terrace. On Sunday January 13 I officially named the station "Davis" after Captain John King Davis, the well-known master of Sir Douglas Mawson's *Aurora* (1911–13) and *Discovery* (1929–30). Its position was determined to be lat. 68° 34·6′ S., long. 77° 57·7′ E. The water problem was solved by the Chief Engineer of the *Kista Dan*, I. Krat, who built for us an electric distilling plant for use with sea water.

The next week was spent in building a station comprising sleeping hut, community hut, engine hut, store hut, balloon-filling shed and auroral observatory, and in carrying out photographic flights over Princess Elizabeth Land and the Amery Ice Shelf. On Sunday January 20 we left a party of four men, led by

meteorologist Robert Dingle, to man this small outpost for twelve months, and sailed for Vincennes Bay, Wilkes Land, for a rendezvous with the United States Antarctic Expedition, which generously had transported seven of our men for whom we had no room in the *Kista Dan*. These men were picked up from U.S.S. *Glacier* on January 25, together with 50 tons of diesel oil for the ship, and we then headed west for Mawson.

Bad weather delayed us somewhat but we arrived at Mawson on February 2 and remained until February 17. During this time three new huts were built, making the total at the station twenty-seven. While we were there Bill Bewsher, OIC of the 1956 Mawson party, returned with four comrades from a three-month field trip by Weasel and dog-sledge which had successfully surveyed the Prince Charles Mountains.

On February 17 *Kista Dan* sailed for Davis, leaving physicist Keith Mather as OIC of a party of twenty-four men at Mawson for 1957. Arriving at Davis on February 20 we stayed only one day, to unload more cargo and to put ashore an additional man, and then sailed for Melbourne by way of Iles de Kerguelen. When we reached Melbourne on 12 March 1957 the ship had completed a voyage of 11,500 miles and Australia's two continental stations were in operation ready for the start of the International Geophysical Year.

A NEW MAP OF SOUTHERN ARABIA

1. BASIS AND COMPILATION OF THE MAP

H. VON WISSMANN

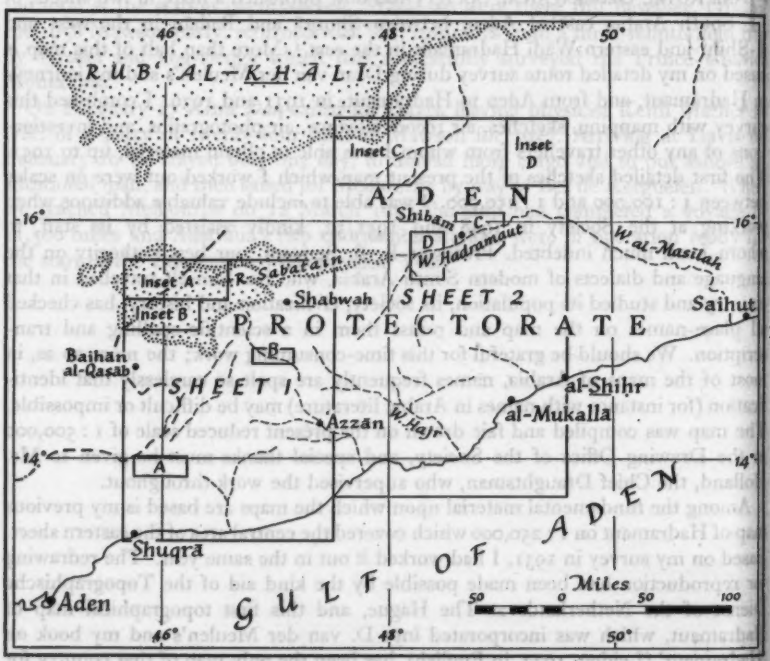
THE ROYAL GEOGRAPHICAL SOCIETY has now published a map, in two sheets, of South Arabia east of Aden, between Shuqrā and Baiḥān in the west and al-Shiḥr and eastern Wādī Ḥaḍramaut in the east.[1] More than half of this map is based on my detailed route survey during Daan van der Meulen's and my journeys in Ḥaḍramaut, and from Aden to Ḥaḍramaut, in 1931 and 1939. I combined this survey with mapping, sketches, air reconnaissance, air photographs, and investigations of any other travellers from whom I was able to obtain material, up to 1951. The first detailed sketches of the present map which I worked out were on scales between 1 : 100,000 and 1 : 250,000. I was able to include valuable additions when working at the Society in 1948 and 1951/52, kindly assisted by its staff, to whom I am much indebted. Professor R. B. Serjeant, our best authority on the language and dialects of modern South Arabia, who has himself travelled in that country and studied its population, its society, civilization and history, has checked all place-names on the map and recast them in a scientific spelling and transcription. We should be grateful for this time-consuming work; the more so as, in most of the maps of Arabia, names frequently are spelt so carelessly that identification (for instance with names in Arabic literature) may be difficult or impossible. The map was compiled and fair drawn on the present reduced scale of 1 : 500,000 in the Drawing Office of the Society, and special thanks must be given to Mr. Holland, the Chief Draughtsman, who supervised the work throughout.

Among the fundamental material upon which the maps are based is my previous map of Ḥaḍramaut on 1 : 250,000 which covered the central area of the eastern sheet. Based on my survey in 1931, I had worked it out in the same year. The redrawing for reproduction had been made possible by the kind aid of the Topographische Dienst of the Netherlands at The Hague, and this first topographical map of Ḥaḍramaut, which was incorporated into D. van der Meulen's and my book on 'Ḥaḍramaut' (Leiden, 1932, in English), has been the only map of that country for many years. A second fundamental map, especially for the north-western area, was that made by H. St.J. B. Philby of his 1936 journey. This was compiled, drawn and published on a scale of 1 : 1,000,000 by the Royal Geographical Society.[2] During D. van der Meulen's and my overland journey from Aden to Ḥaḍramaut and its surroundings in 1939, rendered possible by the kind assistance of the Government of Aden, and especially that of Sir Bernard Reilly, I was again able to carry out a detailed route survey, which supplied the third main basis of the map.

While the excellent map of O. H. Little[3] and the $^1/_4$ inch to 1 mile map of Shuqrā[4] only cover areas of the coastal hinterland, the investigations of routes by Count Landberg[5] were important for large unexplored areas of the western sheet. The map of the area of Baiḥān in the west is the result of the excellent plane-table survey by Dr. F. Heybroek in 1950, member of the expedition of the American Foundation for the Study of Man. In addition the routes of A. von Wrede, Th. Bent, L. Hirsch, H. and D. Ingrams*, W. Bury, Freya Stark, Colonel

Lake*, D. G. Bunker*, W. Thesiger and others, as well as the air reconnaissance of Squadron Leaders Rickards* and Bellerby*, were incorporated; and a preliminary map made by the Iraq Petroleum Company from air photographs*, was utilized.[6]

A reduction of my sketch of the present map on the scale of 1 : 2,000,000 was attached to D. van der Meulen's book 'Onbekend Arabië.'[7] In this book and in its English version 'Aden to the Hadhramaut,' Daan van der Meulen describes our journey in 1939. In both of our common journeys we often seemed to be bewitched, as if taken away from our time, thus living in a medieval world of the



Arabian Nights or—when secluded in still remoter regions—even in pre-Mohammedan antiquity.

In the present map I know of only a few errors. The only important one is in the area belonging to the Yemen near the western border of the map, and is explained in the footnote at the end of the paper.[8] The compilation of the map described here was an integral part of my mapping in South Arabia. A scientific journey in the Yemen in 1927, together with Carl Rathjens (he was my teacher then, in modest travelling in little-known and non-westernised countries) brought us from al-Ḥudaidah to Ṣan'ā' and its surroundings. As guests of Imām Yaḥyā, we were allowed to join his excavation of an ancient temple. My mapping of the region in which we travelled served as a basis for our scientific results.[9] C. Rathjens' surveys on his later journeys in the Yemen[10] (and my own during an enchanting excursion there in 1931) have mostly not yet been published; but they have been compiled by us. I have, besides, begun to work out the extensive route mappings

and geographical investigations of Eduard Glaser in Yemen, carried out during the years 1884 to 1892. His manuscripts now belong to the Vienna Academy and are deposited in Tübingen.[11] Glaser was an orientalist and geographer, who after much strenuous travelling died before he could give a synopsis of his comprehensive notes and collections. He wanted to write a geography and history of the Yemen.[12]

Based on the results of these journeys, mappings and investigations, much of my work deals with South Arabia, its geology, geomorphology and vegetation[13] as well as its human and historical geography and its ancient history.[14] In addition to this, I have written on Arabia as a whole, its geography and its history of colonization.[15] I have also traced prehistoric and historic social and economic processes and developments within the framework of the main climatical zones of the Old World, especially of its dry belt—those steadily evolving but sometimes rapidly spreading changes of early culture and civilization, which are such an essential part of the social geography and history of Arabia.[16]

Most of the geographical work on South Arabia of C. Rathjens and myself would not have been possible without our survey work. Up to now, in particular, both our geological work and that on historical geography were based on our maps. We hope that these may also be a basis for the geographical journeys and studies of a younger generation. There are many diverse and interesting tasks and problems which, however, are no easier or less delicate to approach than they have ever been. We must keep in mind that we ask for access to secluded, distrustful and conservative Mohammedan countries, jealously defending their isolation. This is especially true of the Yemen.

The historical map in 'Beiträge zur historischen Geographie des vorislamischen Südarabien,' on the scale of about 1 : 1,125,000 reaches from the high plateaus of the Yemen to Wādī Ḥaḍramaut, and it shows the four central oases of the ancient South Arabian kingdoms, which were all located round the sandy desert of Ramlat Sab'atain.[17] The map described here shows two of them, Tumna' of Qatabān (Darb Kuḥlān in Baiḥān)[18] and Shabwah of Ḥaḍramaut. Since the early Middle Ages, these four oases have gradually diminished, while nomads immigrated from the north. Thus South Arabia became divided into two countries based on agriculture, the Yemen and Ḥaḍramaut. But while the Yemen became centralized in its high plateaus (Ẓafār, Ṣan'ā'), where crops depend on monsoonal rains, the heart of the Ḥaḍramaut is still an oasis region. This is Wādī Ḥaḍramaut, a ribbon of date-palm gardens and white towns along the dry bed of the sail (sā'il), which is enclosed by the precipices of the limestone strata of a wide and barren table land, the Jaul. The routes from the main valley to the coast have not only to climb the precipice and to cross the high Jaul. They have also to descend a rough "'aqabah" down the mountainous southern breakdown of this plateau to the coastal valleys and plains, finally to reach the hospitable harbour town of al-Mukallā.

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[4] G.S.G.S. 3997, War Office, 1938.

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[6] Wrede, A. v., 'Reise in Hadhramaut,' Braunschweig, 1870; L. Hirsch, 'Reisen in Süd-Arabien etc.' (Leiden, 1897); Th. Bent, 'Southern Arabia' (London, 1900); D. Ingrams in

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[7] Meulen, D. van der, 'Onbekend Arabië' (Amsterdam, 1951). In the English edition, 'Aden to the Hadhramaut' (London, 1947), the map is not included.

[8] This mountainous area of Baiḥân al-Daulah and of the Banyar tribal confederation is nearly unknown to us. The whole region seems to belong to the district of al-Baiḍâ' of the Yemen. The town al-Baiḍâ' is shown in 14° 3′ on the border of the map. So the name of a subdistrict called al-Baiḍâ' in 14° 45′ should be cancelled. The name am-Raṣṣâṣ, written in parenthesis below, was the name of the former independent dynasty of that whole area until at least 1918, when it was in relations with Imâm Yaḥyâ of the Yemen. It is known that in antiquity the Banyar region was tribal territory of 'Ausân and the centre of the kingdom of that name, which for a time had colonies in East Africa as far as modern Tanganyika. According to an unpublished notebook of E. Glaser, 'Ubarah and Miswarah, here in 14° 30′, should be much more to the south, the latter in about 14° 45′. "Miswar" was the capital of a powerful 'Ausân in the fifth century B.C. (*cf.* 'Handbook of Arabia,' I, 1920, pp. 528 f.; Count Landberg, 'Daṭ̣inah,' p. 1817; H. v. Wissmann and M. Höfner—see note 15—p. 58 and map).

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[10] 1931, 1934, 1937/8, *cf.* C. Rathjens, 'Sabaeica,' Vol. I, *Mitt. Mus. Völkerk. Hamb.* Nr. 24, 1953, maps p. 16, 52, 122.

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17 Qarnawu of Ma'în, Mârib of Saba', Tumna' of Qatabân and Shabwat of Ḥaḍramaut. Here the historical map is mainly based on the routes and investigations of E. Glaser.

18 'Tumna' has been partly excavated by the American Foundation for the Study of Man. *Cf.* W. Phillips, 'Qataban and Sheba' (London, 1955). Preliminary publications of W. F. Albright, A. Jamme, F. P. Albright, and G. van Beek in *Bull. Amer. Schools of Oriental Research*, Baltimore, 1952–

2. THE PROBLEM OF THE PLACE-NAMES

R. B. SERJEANT

Establishing the correct form of place-names on Professor von Wissmann's maps has been a long and complicated task. His maps, as he has stated *supra*, are compiled from various sources, and the standard of accuracy in reporting and recording Arabic names varies greatly, from the systematic work of D. van der Meulen and Philby on the one hand, to the somewhat mutilated names of certain other travellers.

Apart, however, from errors arising from mere weakness in Arabic and the lack of competent Arab assistants to rectify it, there are factors which cause the most careful observers to err. Of these the most important element is the peculiarities of the dialects, especially in pronunciation; to this must be added confusion arising from the dictates of classical Arabic spelling. Nor will there always be complete agreement between two Arabs themselves concerning the spelling of some place-name; at times it seems to me that a diminutive name is used along with the ordinary form. Tribal names may sometimes be confused with place-names, an error into which it is all too easy to fall; it is interesting that numerous place-names are identified by the Arabs themselves with eponymous ancestors. There is for example Bal-Ḥâf, and of course Ḥaḍramaut figures also in the genealogies. On the other hand though every town and village in Ḥaḍramaut has a nickname (Saiwûn for example is known as al-Ṭawîlah) these are never a source of confusion.

Working over the place-names on these maps I have concluded that errors have arisen from travellers' incorrect reading of their notes in Arabic or in Roman script—a natural enough source of error in the difficult circumstances under which so many have had to note down their data.

Over the extent of the territories covered by von Wissmann's maps there are divergencies in the actual pronunciation of Arabic, and in the vocabulary current amongst the tribes and peasants. For more detail the Comte de Landberg's *Glossaire Datînois* (Leiden 1920–42) may be consulted, but the following are the principal points of importance:

ج jīm *g*, as in "garden"; *j*, as in "just"; *y*, as in "yard"; sometimes it has an intermediate sound gy.

ظ و ض ḍād and ẓā' most easily described as a sort of palatalized "thee." Both letters of Arabic are pronounced in a way quite indistinguishable to the ordinary ear. They are easily confused by Europeans with dhāl, and Arabs themselves occasionally do the same. In some areas like Wāḥidī territory the ḍād is pronounced like a rolled *l*. Where classical Arabic demands ẓā', the letter *ẓ* has usually been employed; otherwise the letter *ḍ* is used.

غ ghain gh pronounced in some districts like the classical Arabic qāf.

ق qāf *q*, outside Aden is usually pronounced like *g* in "garden," in which case it is almost indistinguishable to European ears from jīm pronounced as *g*. It is also sometimes pronounced like the letter ghain.

The letters sīn and ṣād frequently interchange, and they are, in South Arabia, difficult to distinguish in any case. The letters *l*, *r*, and *n* tend to interchange, but this rarely gives rise to confusion. The long and short vowels are carefully distinguished in the Arabic script, but the colloquial languages are not always consistent in these matters.

In the Western Aden Protectorate the article *am* is widely used for the ordinary *al*, *e.g.* am-Ḥabīl for al-Ḥabīl.

Many technical topographical terms unknown to classical Arabic are used, and some of these have been printed on the margin of the maps. W. Thesiger has published a list of some of these in the *Geographical Journal* (113, 1 (1949), pp. 43–4), but valuable as this is, it requires a final check before absolute acceptance as authoritative. In all cases the area to which a term relates should be specified, for it may not always be applied in quite the same way in other districts from that where it was recorded. It goes without saying that each area has its own favourite topographical terms, some of which may be peculiar to it. I should not care, however, to attempt to define where the particular word, khushm, anf, or nukhr, meaning a "nose", happens to be commonest.

For Ḥaḍramaut the following terms are given by Saiyid 'Alawī b. Ṭāhir al-Ḥaddād (cf. *infra*), but there must be many more which he has not recorded.

جِدْفِر jidfir, a clay stratum of good hard clay (without sand) which may either be on the surface of the ground, or under another stratum of sand or gravel.

حَسْر ḥasr (pl. ḥusūr), a rise in the ground sloping down to ground at a lower level.

حور ḥūr or ḥaur(?), a ḥūr is what lies below a kaur (peak), and J. Ḥuwairah (diminutive form) is below Kaur Saibān.

حَيْق ḥaiq, a low-lying piece of ground (ghaur), or a low-lying strip (tihāmah), opposite an upland (najd).

مخرج makhraj (probable vowelling), see manfar (*infra*).

خطْمَة khiṭmah (pl. khiṭam), the mountains and their deserts.

دُقْم duqm, the highest peak of a mountain, or a mountain overlooking a wādī or pass, ravine (shi'b).

رمضة ramḍah (probable vowelling), dwelling or village, a word used only in Jābirī and Ḥamūmī territory.

سنبك sunbuk, land without vegetation and valueless, a word also found in classical Arabic.

الصُّرُوم al-ṣurūm, dwellings of the Bedouin.

صَيْقة ṣaiqah, a fissure at the top of a mountain in which water flows to the foot. It is also called al-ṭāriḥ.

ضمر ḍamr, mouth of a wādī. Cf. manfar (*infra*).

طارح ṭāriḥ, cf. ṣaiqah (*supra*).

عِرْقَة 'irqah, a road in the mountain, narrow and difficult, which beasts cannot manage.

مفتك maftak (probable vowelling), see manfar (*infra*).

قِرِة qirih, a level piece on the "ḥaid al-jabal," *i.e.* the mountain wall, like a wing or rock for circumambulation (maṭāf); here ibex are generally found.

قيوم quyūm (vowelling uncertain), middle of the main wādī to which other wādīs return. This is dialect of Upper Ḥaḍramaut only.

منفر manfar (probable vowelling), the mouth of a wādī (makhraj), and where it widens and flows into another; the mouth of a wādī at the parting of two mountains to its right and left, or of one of them, it then flowing to a wide space in the land, or to another wādī opposite. Synonyms are ḍamr, makhraj, maftak.

نقبة naqabah (pl. niqāb), a hole excavated to hold rainwater, wide at the bottom, about a man's height. This has already been noted by van der Meulen and von Wissmann.

هِشْم hishm (pl. hushūm), broken high ground.

مَنْتَرَة mantarah (my own observation), a part of the road cutting down through the clay bank to a wādī bed, and up through the clay bank on the other side.

There are a great many elements of place-names which are not strictly speaking topographical. For example there are the sacred enclaves and sanctuaries known as Ḥauṭah and Ḥabaṭ, the various stones and rocks which are objects of veneration, or others which are stoned by every passer-by and bear names like al-Rujaimah. The names of irrigation or agricultural works often figure in place-names, such as ḍamd, an acre, saum, a clay bund, maḍla'ah and sudd, dams. A very large number of these words is not to be found in the classical dictionaries.

In the Eastern Aden Protectorate many names of localities must certainly belong to the Mahrah group of dialects rather than to the Arabic tongue, and even in the Western Protectorate a large number of local names must belong to the pre-Arabic

languages of the area, though it is difficult to draw any hard and fast linguistic dividing line.[1]

A modified form of the R.G.S.2 system of transliteration has been employed, and the different sibilants, dentals, etc., have been distinguished by dots, while in such cases where two letters are used to represent a single Arabic letter, they have been linked by underlining. Long vowels are marked by a stroke above them. As short vowels in Arabic are to some considerable extent variable, inconsistencies may be found, but I do not regard this as a serious matter.

Where there is an authority for a place-name I have provided a reference in the sheets sent to Mr. G. S. Holland, though even printed sources sometimes differ in their spellings. Some names for which I could find no authority are, from their sense, virtually certain to be correct. Where there is no authority, as little change as possible has been made, and that only in order to make the name recorded fit the system of transliteration—such changes have sometimes not been made without misgivings. At a very rough guess I should estimate that perhaps 70 per cent. of the names will be correct, but it must be emphasized that correction is still only partial, and those working in the field are invited to make their own corrections.

The Western Aden Protectorate districts covered by these maps lie so much outside the main areas of Islamic civilization that they figure little in South Arabian literature; anything written on them is still in MS.; but this is not the case with Ḥaḍramaut which is an ancient centre of culture and, relatively speaking, well documented. For the Western Protectorate I have relied on Landberg's excellent works, 'Arabica' IV and V, which, though written about sixty years ago, are still immensely valuable today, and on the geographical names in his *Daṯ̲īnah*. Aden newspapers have supplied some names, and my own notes from my forthcoming study on the 'Awd̲halīs, on Dath̲īnah, and in fact all up the road to Ḥaḍramaut, have supplemented Landberg to some extent. Mr. E. R. Johnston and Muḥammed Farīd of the Aden Political Service assisted me considerably with the large number of places in Upper 'Awlaqī territory not to be found in Landberg's works.

For Ḥaḍramaut my chief source was Saiyid 'Alawī b. Ṭāhir's *al-Sh̲āmil fī Tārīkh Ḥaḍramaut* which has a romantic history, for proofs were in the press when the Japanese seized Singapore, but the book was never published as they destroyed the press or frames. Saiyid 'Alawī had however sent some batches of proofs to Ḥaḍraumaut for criticisms, and a photograph of part of this work is now in the library of the School of Oriental and African Studies. The geographical introduction is detailed and has proved invaluable. I also used an MS. of Saiyid Aḥmad al-'Aṭṭās's *Risālah*, Saiyid Muḥammad b. Hāsh̲im's *Riḥlah* and *Tārīkh*, the late Sulṭān Ṣāliḥ's *Riḥlah*, and other sources, including my own field notes. Where these sources differed from *al-Sh̲āmil* I have preferred the latter. For the peripheral areas to the north and east of Ḥaḍramaut valley there was nothing written at my disposal, but I am indebted for assistance to Mr. P. Booker of the Residency staff, and to Sh̲aikh Muḥammad Bā Maṭraf, Assistant State Secretary in al-Mukallā.

It is pertinent to remark that many present-day names of tribes and localities occur in al-Hamdānī's geography and in the medieval genealogical work the *Ṭurfat al-Aṣḥāb*. The amazing continuity in the historical geography of Southern Arabia may be perceived by a perusal of Professor von Wissmann's and Maria Höfner's initial 'Beiträge z. hist. Geographie des vorislamischen Südarabien.'

There is one new problem in the mapping of Arabia which is of no small interest to an Arabist. Professor C. D. Matthews, now of the Arabian Research Division of Aramco, has pointed out in a short paper "Non-Arabic Place Names in Central

South Arabia" presented to the XIVth International Congress of Orientalists at Munich in 1957, the difficulties of establishing a system of transliteration for place-names in "central South Arabia."

For some time Professor Matthews has been working on the geography and tribes of this area and progress has been made by Aramco towards a satisfactory map of the region. I was privileged as a guest at Aramco in 1954 to observe the methods employed at Dhahran. Sitting in a comfortable air-conditioned office the scholar has a group of native informants employed by Aramco at his disposal, to provide him with such information as they have on the language and topography of the districts under study. These informants are retained so long as they are relevant, and then appropriate tribesmen employed for new districts. In the case of the Mahrah areas—which are not in Sa 'ūdī Arabia—it is of course not possible to check up in the field and in person, but valuable work can be done by this method. Certainly Aramco has concerned itself with the accurate presentation of Arabic names in a way that I imagine no other oil concern has done, and in a way that is unknown to surveyors employed on Arabian territories under British control.

Professor Matthews states that in the areas where Mahrī, Ḥarsūsī, Baṭḥarī, and Shaḥrī (not Shaurī) are spoken, they keep alive a number of their own geographical names as well as those derived from Arabic. In transcribing these names he says, "one is faced by the problem of consonant sounds that can only be approximated in Western phonetic systems, and by both consonant and vowel sounds that will require a special representation in Arabic." It will therefore be necessary to devise a special new system of transliteration for this area. Existing maps of it, apart from such of the Aramco work as the writer has seen, do not seem to have faced up to the problem at all; and who in fact is there but Professor Matthews with sufficient practical field knowledge of their languages to devise a system of transliteration? It should be stressed however that with the opening of Mahrah territory today by oil prospecting, and with the extension of *de facto* control over it by Britain as a protecting power, this is a cartographical problem which needs to be tackled soon.[2]

This map, on the scale of 1 : 500,000, and on two sheets, covers the area shown on the figure on p. 164, and is obtainable only from the Office of the Society. The cost to members of the public is 12*s* 6*d* a sheet (£1 for two sheets), and to Fellows 7*s* 6*d* a sheet (15*s* for two sheets). Postage and packing are 2*s* extra. A gazetteer of names shown on the map is in preparation.

[1] The Shaḥrī tribes who are not infrequently mentioned in the old chronicles of Ḥaḍramaut have given their name to its important port, al-Shiḥr. In this and other areas one would therefore look for survivals of their language in local place-names.

[2] Professor Matthews puts forward an interesting proposition, namely that the element Bal in place-names east of Ḥaḍramaut, means ba'l, lord of, owner of, and does not stand for Ibn or Abū as it has been assumed is the case in Ḥaḍramaut. Though in MSS. Bā in such contexts is often spelled Abā (for all three cases), I am far from inclined to discount the possibility that this might also apply to at least some names in Ḥaḍramaut beginning with the characteristic Ḥaḍramī Bā.

PIONEER MAPS OF HEALTH AND DISEASE IN ENGLAND

E. W. GILBERT

AT THE PRESENT TIME there is a lively interest in medical geography. A great atlas of the distribution of diseases is being compiled under the auspices of the American Geographical Society. The International Geographical Union has established a Commission on medical geography, defined as "the study of geographical factors concerned with cause and effect in health and disease:" the Commission presented its first report at Washington in 1952. British geographers have published papers on the ecology of disease in such journals as the *Practitioner* and the *British Medical Journal*. In view of all this activity it is right that the work of the nineteenth century pioneers in the drawing of maps of health and disease should be remembered, especially as some of the leading medical cartographers were Fellows of the Royal Geographical Society. The object of this paper is to describe a few of the maps constructed by these pioneers and to explain the significance of their cartographic achievements.[1]

Much of the subject matter of what is now called medical geography is as old as Hippocrates and his 'De Aëre, Aquis et Locis.' Even the term "medical geography" is not new.[2] It has been current in England for at least sixty years, as it was used by Dr. Alfred Haviland in his 'Geographical distribution of diseases in Great Britain,' published in 1892. In the introduction to this book Haviland wrote of "medical geography," and on p. 286 he referred to "the medical geography of cancer." In 1891 he read a paper in London to the Seventh International Congress of Hygiene on "the influence of clays and limestones on medical geography; illustrated by the geographical distribution of cancer among females in England and Wales." But it appears that the term "medical geography" was preceded by "medical topography." For instance, in 1830 Dr. John Hennen published his 'Sketches of the medical topography of the Mediterranean,' which contains full and systematic geographical accounts of Gibraltar, Malta and the Ionian Islands. In this book the geography of the areas named, all of which were then occupied by British naval and military forces, is described in relation to health and disease. The author also prepared an elaborate scheme for publishing a series of 'Memoirs on medical topography,' but his plan was never carried out. He proposed that each memoir should describe the physical geography including the relief, climate and vegetation of selected areas, and that this description should be followed by an account of the population, its dwellings, bedding, clothing, furniture, diet, employment, amusements, customs, morals and so forth. A third part of each memoir was to be devoted to diseases, hospitals, longevity and vital statistics. His own book

[1] An outline of this paper was read at the Washington meeting of the I.G.U. to the Commission on Medical Geography on 11 August 1952, on behalf of the author, by Professor R. W. Steel, under the title "Some early English maps of the geography of health and disease."

[2] In Germany the term "medical geography" was used earlier than in England. A book entitled 'Medizinische Geographie' by C. F. Fuchs was published at Berlin in 1853. For the history of maps of disease in Germany see H. J. Jusatz, "Zur Entwicklungsgeschichte der medizinisch-geographischen Karten in Deutschland," *Mitt. Reichsamts Landesaufn.*, 1939, pp. 11–22.

contains material of this kind and is a valuable source of information about conditions then prevailing in Mediterranean lands.[1]

Books on medical topography appeared in many countries in the nineteenth century. Some of these dealt with single towns, for example, M. Murat, 'Topographie médicale de la ville de Montpellier' (1810); and R. H. Powell, 'A medical topography of Tunbridge Wells' (1846). Other books described provinces or districts: J. B. Pesétri y Vidal, 'Topografía médica de Valencia' (1878) was one of several similar works on the medical topography of Spanish provinces. In England, partly as a result of the efforts of Dr. (later Sir) James Clark (1788–1870), whose well-known book on 'The influence of climate in the prevention and cure of chronic diseases' was first published in 1829,[2] a considerable number of works on what might be called the "medical climatology" of English towns and districts began to appear. Notable among these was a detailed memoir on the medical topography of a part of Cornwall by Dr. John Forbes (1787–1861), a schoolfellow and life-long friend of Sir James Clark.[3] Other contributions were Dr. Thomas Shapter's 'The climate of the south of Devonshire; and its influence upon health' (1842); and Dr. A. L. Wigan's 'Brighton and its three climates with remarks on its medical topography' (1843). In his book on climate Dr. Clark praised the then unknown Ventnor in the Isle of Wight as a health-giving winter resort; his commendations sent up the price of building land at that seaside village from £100 per acre to £800 or £1000 in a very few years.

These early writers on "medical topography" did not include the mapping of the distribution of diseases as part of their studies. The great outbreaks of cholera in the first half of the nineteenth century seem to have been the factor which first stimulated cartographic work of this kind. It has been stated recently in the *Journal* that the period 1835–55 can be regarded as "a 'golden age' of the development of geographic cartography,"[4] and it is true to say that the mapping of diseases began in England during those years as did the mapping of the distribution of population.

Asiatic cholera reached Great Britain in October 1831 the first death occurring in that month at Sunderland.[5] During the epidemic of 1831–2 over 52,000 persons died of cholera in the British Isles, including nearly 22,000 in England and Wales, 21,000 in Ireland and over 9600 in Scotland. In 1848–9 a second epidemic of cholera caused over 53,000 deaths in England and Wales alone; while in 1853–4 there were over 20,000 deaths from this cause in the two countries; and over 14,000 in 1866. There were a few cholera deaths in 1873, and in 1893 there

[1] Dr. W. Arnold added an appendix on "Medical Topography of the different military stations in Jamaica" to his 'Practical treatise on the bilious remittent fever' (1840).

[2] Sir James Clark (as he had become) republished this book in 1841 under a new title: 'The sanative influence of Climate: with an account of the best places of resort for invalids in England, the south of Europe, etc.' As a young man Clark had assisted W. E. Parry, the Arctic explorer, to make some experiments on the temperature of the Gulf Stream.

[3] John Forbes, "Sketch of the medical topography of the Hundred of Penwith, comprising the District of the Landsend in Cornwall," *Trans. Provincial, Medical and Surgical Assoc.*, 2 (1834), 32–147; 4 (1836), 152–261. One of the aims of this Association was to promote the "increase of knowledge of the medical topography of England, through statistical, meteorological, geological and botanical enquiries," and its early volumes include a number of papers on medical topography.

[4] Robinson, Arthur H., "The 1837 maps of Henry Drury Harness," *Geogr. J.*, 121 (1955), p. 440.

[5] Underwood, E. Ashworth, "The history of cholera in Great Britain," *Proc. R. Soc. Med.*, 41 (1948), pp. 165–73.

were 135 deaths, this being the last year in which cholera gained a foothold in Britain.

It is well known that Dr. John Snow (1813–58), a famous London anaesthetist, was largely responsible for demonstrating the water-borne origin of cholera. In his short essay 'On the mode of communication of cholera,' published in 1849, he urged the necessity of providing sewage-free water for south and east London as a preventive of cholera: the second edition (1855) was a substantial enlargement of the original pamphlet.[1] Moreover, the second edition included a map of the dis-

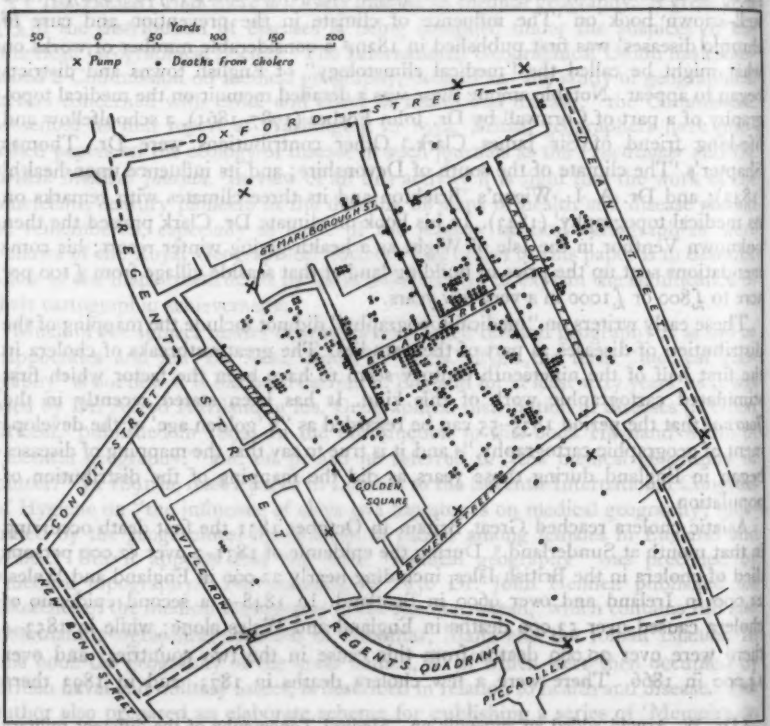

Fig. 1. Dr. John Snow's map (1855) of deaths from cholera in the Broad Street area of London in September 1854

tribution of deaths from cholera in the Broad Street district of London in 1854. The "cholera field," as Snow called it, had its centre at a pump in Broad Street near Golden Square, and the "field" was bounded roughly by Great Marlborough Street, Dean Street, Brewer Street and King Street. In this small space there were over 500 deaths in ten days of September 1854. The scale of the original map is 30 inches to 1 mile; deaths are shown by black rectangles and the pumps are also marked (Fig. 1). Snow proved "that the incidence of cholera was only among

[1] Snow's important papers have been reprinted in 'Snow on cholera, being a reprint of two papers by John Snow, M.D.' with a memoir by B. W. Richardson, and an introduction by W. H. Frost (New York, 1936). The Broad Street map is reproduced in this book.

persons who drank from the Broad Street pump." On September 8, at Snow's urgent request, the handle of the Broad Street pump was removed and the incidence of new cases in the area ceased almost at once. Snow's map of the distribution of deaths from cholera, first published in 1855, is a very significant document in the history of medical geography, but it is not the first map of its kind.

The 1832 outbreak of cholera was particularly severe in Yorkshire.[1] In Leeds, then a place of 76,000 people, there were over 1800 cases and 700 deaths between May and November of 1832. Dr. Robert Baker illustrated his 'Report of the Leeds Board of Health' (1833) with a "cholera plan," surveyed by Charles Fowler, on

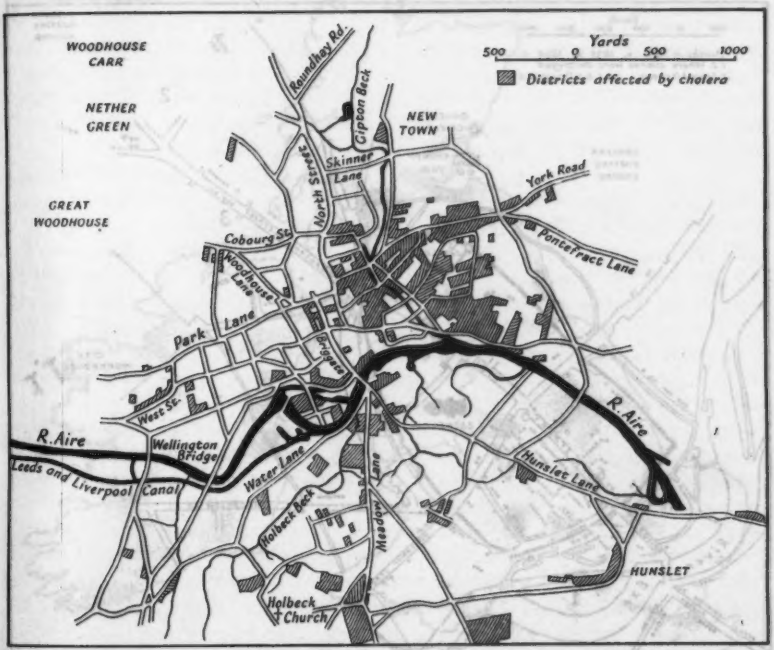

Fig. 2. Dr. Robert Baker's "cholera plan" of Leeds (1833)

which the parts of Leeds affected by cholera were marked and coloured red. Dr. Baker's map showed that the incidence of the disease was highest in the more densely peopled and north-eastern districts of the town and that comparatively small areas were affected in those parts of Leeds that lie south of the river Aire. The plan is on a scale of about $3\frac{1}{2}$ inches to 1 mile and indicates by hatching "the districts in which the cholera prevailed"; it does not mark individual cases or deaths (Fig. 2). Dr. Baker observed (p. 10) "how exceedingly the disease has prevailed in those parts of the town where there is a deficiency, often an entire want of sewerage, drainage, and paving."

In 1848 W. P. Ormerod in 'The sanatory condition of Oxford' included a rather

[1] Underwood, E. Ashworth, "The history of the 1832 cholera epidemic in Yorkshire," *Proc. R. Soc. Med.*, 28 (1935), pp. 603–16.

crude plan of the city on the scale of about 12 inches to 1 mile to show the districts visited by cholera and by fever in 1832. Localities of fever were marked by a cross and those of cholera by a dot, while the parts of the city "chiefly visited by disease generally" were slightly shaded. In 1849 Dr. Thomas Shapter (1809–1902), who had a reputation for his work in both geology and climatology as well as in medicine, published his 'History of the cholera in Exeter in 1832.' This admirably written account has been described by Dr. E. Ashworth Underwood as "one of the best descriptions extant of an historical epidemic." [1] Exeter, which then contained a population of about 28,000, had over 1100 cases of cholera with 402 deaths in 1832.

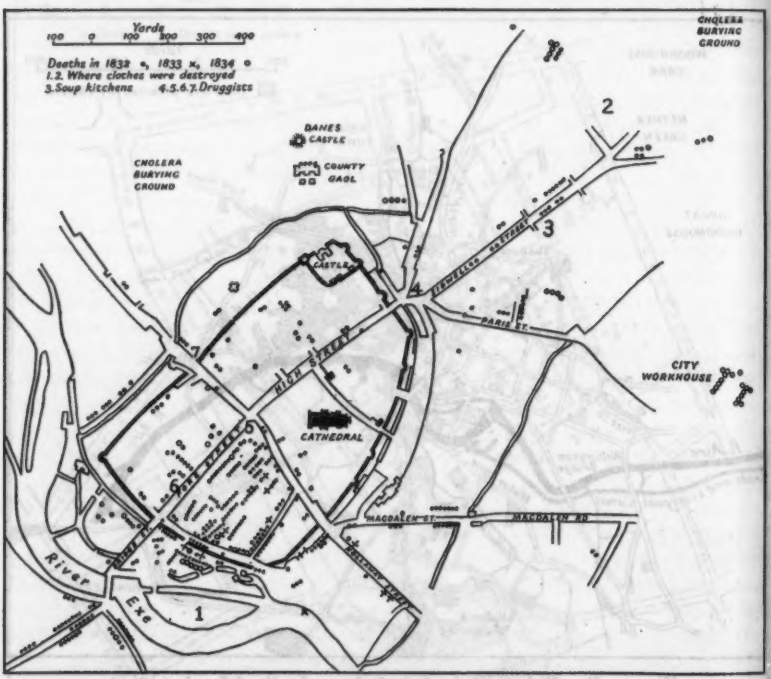

Fig. 3. Dr. Thomas Shapter's map (1849) of the deaths from cholera in Exeter 1832–34

Shapter's book is important in the history of medical geography because, six years before Snow's famous map was published, it included a dot map showing the distribution of deaths caused by cholera. The original map, drawn on a scale of 6 inches to 1 mile, distinguishes the deaths which took place in the years 1832, 1833 and 1834, by different symbols for each year. It also marks the places where clothes were destroyed, the cholera burying grounds, the druggists and the soup kitchens. A redrawing of this plan of Exeter is reproduced as Figure 3, and shows

[1] Underwood, E. Ashworth, "The cholera epidemic in Exeter, 1832," *Brit. Med. J.* 1933 (i), pp. 619–20. R. H. Mottram in 'Early Victorian England 1830–1865' (1934) (ed. G. M. Young), in his chapter on "Town life and London" (Vol. I, 155–66) quotes freely from T. Shapter's 'History of the cholera in Exeter in 1832' (1849).

that a large proportion of the deaths occurred in the low-lying south-eastern quarter of the old walled city. In 1853 Shapter published his 'Sanitary measures and their results,' as a sequel to his previous work on cholera in Exeter in 1832. He pointed out that Exeter suffered only 43 deaths in the epidemic of 1849 and attri-

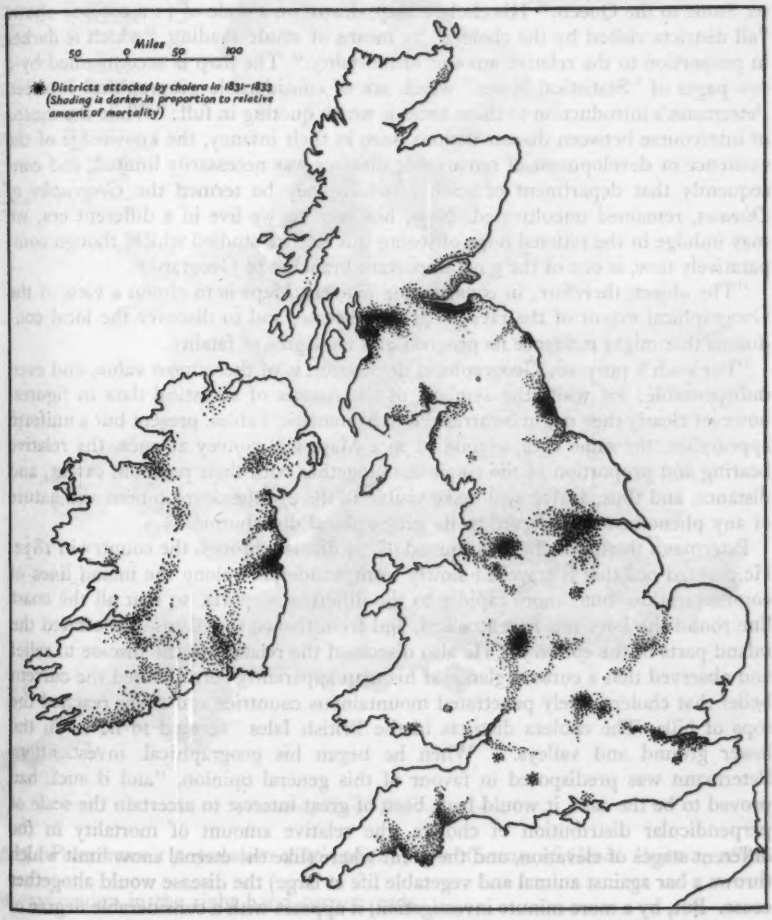
50 0 Miles 50 100
Districts attacked by cholera in 1831–1833
(Shading is darker in proportion to relative amount of mortality)

Fig. 4. Augustus Petermann's cholera map (1852) of the British Isles showing areas affected in 1831–3

buted the city's comparative immunity from the disease to the sanitary improvements carried out in the previous seventeen years.

In 1852, Augustus Petermann (1822–78), the distinguished German geographer, at that time resident in England, brought out a "Cholera map of the British Isles showing the districts attacked in 1831, 1832 and 1833." A redrawn copy of this

map is reproduced as Figure 4.[1] Petermann had worked with the firm of Berghaus at Potsdam from 1839 to 1845. He then migrated to Britain, first living in Edinburgh from 1845 to 1847, where he worked with Alexander Keith Johnston; and then in London until 1854.[2] He was elected a Fellow of the Royal Geographical Society in 1846 and in 1852 was described as "Physical Geographer and Engraver on Stone to the Queen." His cholera map, drawn on a scale of 1 : 2,200,000 shows "all districts visited by the cholera" by means of crude shading, "which is darker in proportion to the relative amount of mortality." The map is accompanied by a few pages of "Statistical Notes" which are of considerable geographical interest. Petermann's introduction to these notes is worth quoting in full: "While the means of intercourse between distant nations were in their infancy, the knowledge of the existence or development of remarkable diseases was necessarily limited, and consequently that department of science, which may be termed the *Geography of Diseases*, remained uncultivated. Now, however, as we live in a different era, we may indulge in the rational hope of seeing this science studied which, though comparatively new, is one of the most important branches of Geography.

"The object, therefore, in constructing Cholera Maps is to obtain a view of the Geographical extent of the ravages of this disease, and to discover the local conditions that might influence its progress and its degree of fatality.

"For such a purpose, Geographical delineation is of the utmost value, and even indispensable; for while the symbols of the masses of statistical data in figures, however clearly they might be arranged in Systematic Tables, present but a uniform appearance, the same data, embodied in a Map, will convey at once, the relative bearing and proportion of the single data together with their position, extent, and distance, and thus, a Map will make visible to the eye the development and nature of any phenomenon in regard to its geographical distribution."

Petermann then described the spread of the disease through the country in 1832. He pointed out that it travelled slowly from Sunderland along the inland lines of communication, but "more rapidly to the different seaports, so that all the coast line round the Isles was first attacked, and from thence the disease penetrated the inland parts of the country." He also discussed the relation of the disease to relief and observed that a cursory glance at his map apparently corroborated the current belief that cholera rarely penetrated mountainous countries and never reached the tops of hills. The cholera districts in the British Isles "seemed to lie all in the lower ground and valleys." When he began his geographical investigations Petermann was predisposed in favour of this general opinion, "and if such had proved to be the case, it would have been of great interest to ascertain the scale of perpendicular distribution of cholera, the relative amount of mortality in the different stages of elevation, and the point where (like the eternal snow limit which throws a bar against animal and vegetable life at large) the disease would altogether cease. But, by a more minute investigation, it appears with a considerable degree of

[1] A facsimile of the original of this map is in H. J. Jusatz, "Die geographisch-medizinische Erforschung von Epidemien," *Peterm. Geogr. Mitt.*, 86 (1940), pp. 201–4.

[2] In connection with Petermann's association with H. Berghaus and A. K. Johnston it is worth noticing that the first maps of the geographical distribution of diseases to appear in any German atlas were in Band II, Abt. VII, No. 2 (1847) of Heinrich Berghaus, *Physikalischer Atlas* (1837–48). The first similar map in England is in A. K. Johnston, *The Physical Atlas of Natural Phenomena* (second ed. 1856). The latter contains a world map of the geographical distribution of health and disease (plate 35) with text by A. K. Johnston; a red line traces the march of cholera from east to west, with dates of its occurrence. This map does not appear in the first edition (1848) of the atlas.

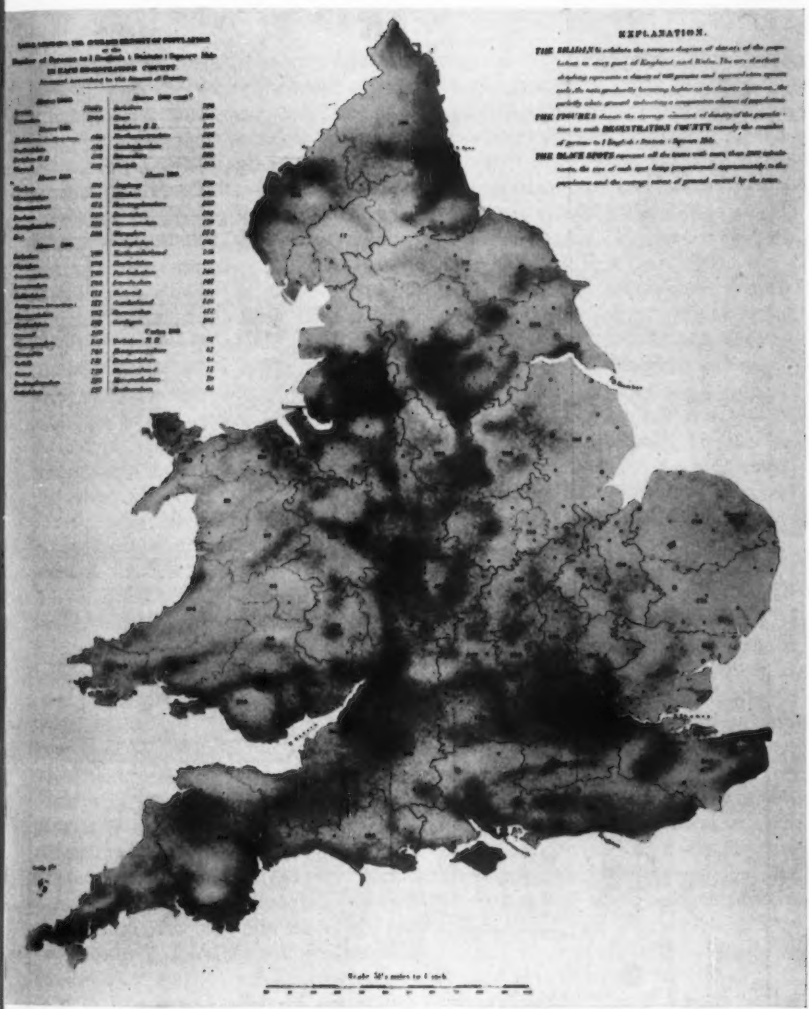

Fig. 5. Petermann's population map (1852) from 'Census of Great Britain, 1851'

The explanation in the right hand corner reads:

THE SHADING exhibits the various degrees of density of the population in every part of England and Wales. The very darkest shading represents a density of 600 persons and upwards to a square mile; the tints gradually becoming lighter as the density decreases—the perfectly white ground indicating a comparative absence of population.

THE FIGURES denote the average amount of density of the population in each REGISTRATION COUNTY, namely the number of persons to 1 English (Statute) Square mile.

THE BLACK SPOTS represent all the towns with more than 2000 inhabitants; the size of each spot being proportioned, approximately, to the population and the average extent of ground covered by the town.

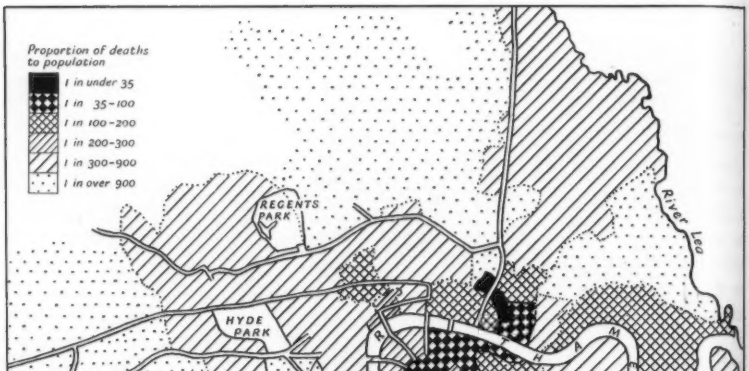

Fig. 6. Petermann's map of deaths from cholera in London in 1832 (1852)

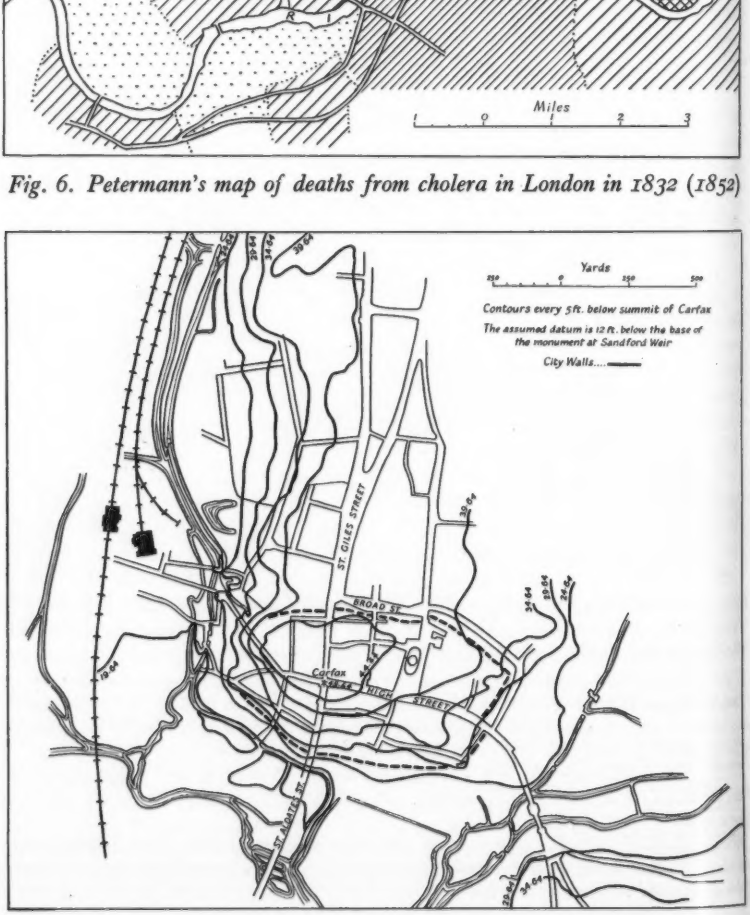

Fig. 7. H. W. Acland's contoured plan of Oxford (1856)

certainty that these districts were attacked, not so much in consequence of their *low situation*, as from the *great amount of population they contain*."

In 1848 Petermann had compiled and drawn a fine population map of the British Isles on the basis of the census of 1841.[1] He was later called on to design a population map of England and Wales (Fig. 5) and another of Scotland to illustrate the 'Census of Great Britain, 1851' (1852). These two engraved maps, drawn on a scale of 31¼ miles to 1 inch, show, by very delicate shading, the differences in density of population, the darkest shading being used for a density of 600 persons and upwards per square mile. Petermann said in his "Statistical Notes" that a comparison of his population maps with his cholera map showed "that the more densely peopled districts were proportionately the most severely attacked." He said that while the "great level of the Fens" did not suffer much from cholera, "the elevated land of Birmingham, forming a pretty extensive plateau of 500 feet mean elevation" was one of the most severely afflicted parts of the whole kingdom. This proved, according to Petermann, that altitude was of little significance in the spread of cholera and that density of population was of far greater importance. He also included some interesting remarks on the influence of the seasons on the progress of the disease, illustrated on his map by an inset diagram of "the number of places of Great Britain attacked by the disease in different months." As a result of his investigations he concluded that "the warmer season favours the progress of the disease," and that "cholera forms a tolerably regular course, ascending rapidly from May to August, attaining in that month its summit, and then descending again with equal rapidity till November, from which month till May it keeps a pretty low ebb."

Petermann's cholera map of the British Isles also contains an inset plan of London divided into 43 registration districts; and detailed tables of the number of cases of cholera, the deaths, the total population and the proportion of deaths to population in each district. On this plan (Fig. 6) six different tints of red or pink were used to indicate the varying proportions of deaths from cholera to total population in the outbreak of 1832. Petermann adopted a scale ranging from one death in 35 persons for the worst district of Botolph (without Aldgate) to one in 900 persons or more for areas least affected and applied the appropriate tint to each registration district. The plan gives some idea of the distribution of the districts most seriously affected in 1832; they included Southwark, Bermondsey and the City.

About 5000 persons died in London in the outbreak of 1832, another 1000 in 1848–9, and over 10,700 in the severe epidemic of 1854.[2] In 1866 there were over 5500 deaths in London, mainly distributed in the East End and not so largely in Southwark and other parishes south of the Thames as in previous outbreaks.

In 1856, one year after the publication of John Snow's map of cholera in the Broad Street area of London, Dr. Henry Wentworth Acland (1815–1900) produced his 'Memoir on the cholera at Oxford in the year 1854.' Oxford experienced three outbreaks of cholera, with 95 deaths in 1832, 75 in 1849 and 129 in 1854. Like

[1] 'Map of the British Isles elucidating the distribution of the population based on the census of 1841' (London, 1849). This map, compiled and drawn by Augustus Petermann on a scale of 1 : 1,600,000 was exhibited to the statistical section of the British Association for the Advancement of Science at Swansea in 1848; and Petermann read a paper on the subject to the section. See *Geogr. J.*, 121 (1955), pp. 448–50.

[2] The official Report of the General Board of Health on the cholera epidemic of 1849 includes a rough "Cholera Map of the Metropolis, 1849," which indicates by very crude shading the districts of London most affected; as well as a similar map of Glasgow. See *British Parliamentary Papers*, 21 (1850). Dots showing deaths from cholera in London in 1866 were drawn superimposed on "maps of the geological formations" in the *Report of Medical Officer for the Privy Council for 1866* (London, 1867).

Petermann, Dr. Acland was a Fellow of the Royal Geographical Society, having been elected in 1855, and his geographical interests are clearly revealed by the remarkable maps in his book. His detailed plan of the city of Oxford is on a scale of approximately 10 inches to 1 mile. In addition to marking rivers and streams the plan has contours drawn at intervals of 5 feet below the summit of Carfax, the highest point in the old city (Fig. 7). Carfax is marked as 49·64 feet above an assumed datum which is a point 12 feet below the base of the monument at Sandford

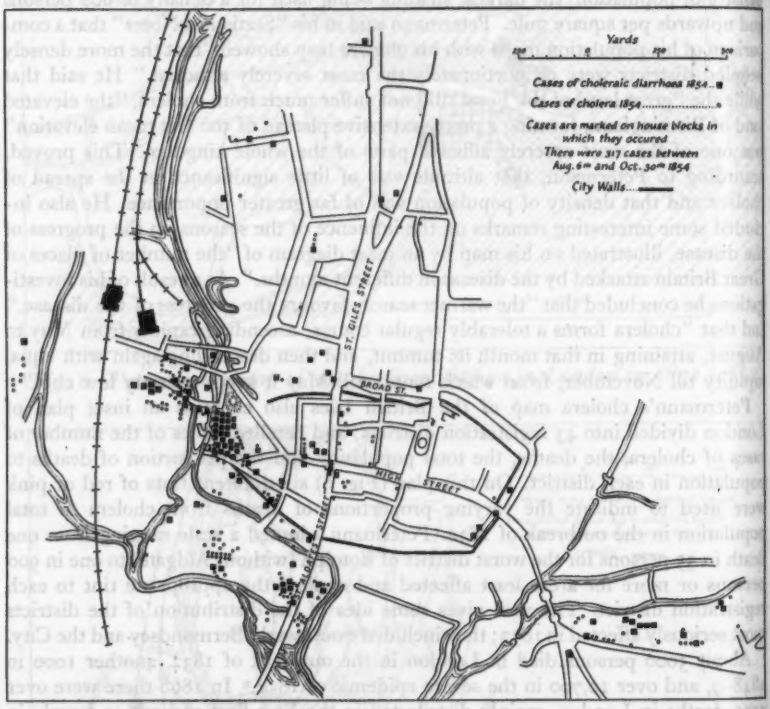
Yards
200 0 200 300
Cases of choleraic diarrhoea 1854..
Cases of cholera 1854.....
Cases are marked on house blocks in which they occured
There were 317 cases between Aug. 6th and Oct. 30th 1854
City Walls.....
ST. GILES STREET
BROAD ST.
HIGH STREET

Fig. 8. H. W. Acland's map of cases of choleraic diarrhoea and cholera in Oxford in 1854 (1856)

Weir. By this curious arrangement the first 5-foot contour below Carfax is marked 44·64 feet, the next 39·64 feet and so on. Contours had been introduced into the maps of the Ordnance Survey by Colonel T. F. Colby, R.E. (1784–1852) in about 1830, but it was still unusual in 1856 to make a plan of a city with contours at such a close interval. Certainly these 5-foot contours give a clearer and more detailed picture of the relief of the old walled city of Oxford, standing on a gravel terrace about 25–30 feet above the normal level of the river, than do most modern maps. Dr. Acland obtained these contours from the unpublished drawings of Robert Syer Hoggar, an engineer.[1] The plan (Fig. 11) shows by colour and symbols the

[1] Hoggar calculated that the summit of Carfax was 37 feet above the average level of the water under Folly Bridge. The difference between Carfax (209 feet above sea level) and the

parts of the city still undrained in 1855, and the rivers and streams that were then contaminated by sewers as well as the points of contamination. By blue symbols of different shapes the cases of cholera in the 1832 epidemic can be differentiated from those of 1849 (Figs. 9 and 10); both sets of cases are marked in the streets in which they occurred. For the epidemic of 1854, by using two different black symbols, Dr. Acland distinguished the cases of choleraic diarrhoea from those of cholera, and for that year he was able to plot each case in the actual house block concerned (Fig. 8). Acland's map also marks by special symbols those parts of the city which

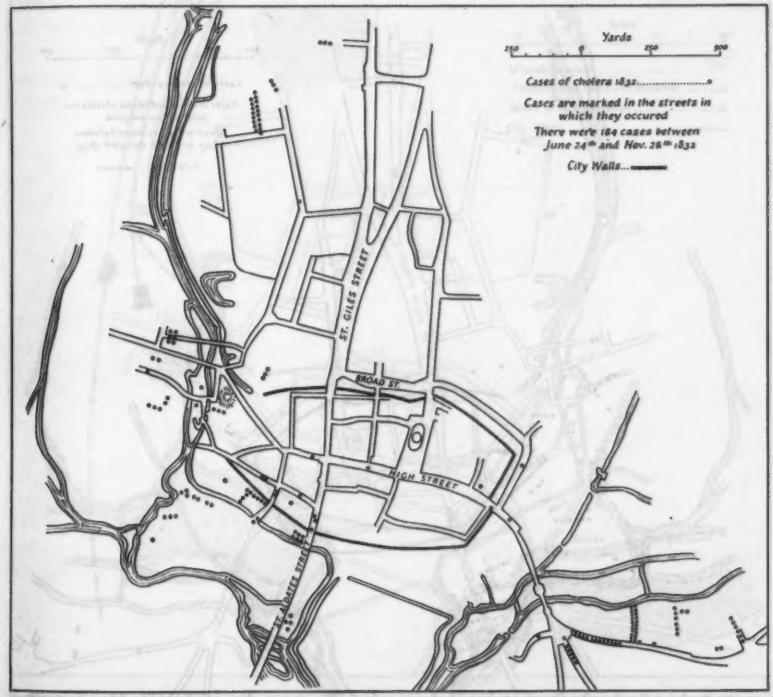
Yards
250 0 250 500
Cases of cholera 1832
Cases are marked in the streets in which they occured
There were 184 cases between June 24th and Nov. 28th 1832
City Walls
ST. GILES STREET
BROAD ST.
HIGH STREET

Fig. 9. H. W. Acland's map of cases of cholera in Oxford in 1832 (1856)

had been described by W. P. Ormerod and others some years earlier as unhealthy; those which had been wholly remedied; and those which had been partly remedied since they wrote.

Acland's plan of Oxford is the most elaborate in the whole series of cholera maps. It is not possible to discuss Acland's text fully, but it should be noted that, like Petermann, he carefully considered the relation of cholera mortality to altitude. Acland did not reach the same conclusions as Petermann, but followed the opinions

average level of water under Folly Bridge (179 feet above sea level) is now 30 feet. The difference of 7 feet between the measurement of 1856 and that of 1958 is mainly due to changes in the level of the river which occurred after the construction of weirs and partly to alterations at Carfax itself. Hoggar's published plan of Oxford is dated 1850, but the copy in the Bodleian shows contours in manuscript only.

expressed in the Registrar General's Report on cholera in 1849, that altitude in London had "a more constant relation with mortality from cholera than any other human element." Acland took his contour line marked 29·64 feet (Fig. 7) as a division between an upper and a lower level in Oxford. This contour was 16·47 feet above the average water level at Folly Bridge and 20 feet below Carfax. He calculated that in the three Oxford epidemics 141 cases occurred in the upper level and 362 in the lower, and estimated the population in the upper level at 4,200, and that in the lower at 12,300. He concluded "that mortality on our lower

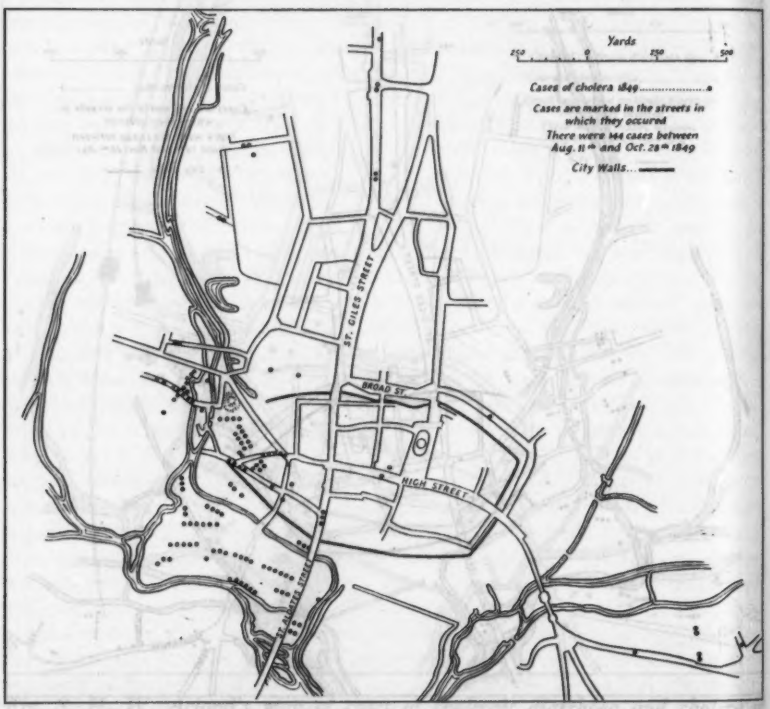
Yards
250 0 250 500
Cases of cholera 1849
Cases are marked in the streets in which they occured
There were 144 cases between Aug. 11th and Oct. 28th 1849
City Walls
ST. GILES STREET
BROAD ST.
HIGH STREET
ST. ALDATES STREET

Fig. 10. H. W. Acland's map of cases of cholera in Oxford in 1849 (1856)

level was proportionately three times as great as that of our upper level."[1] Acland's contour correlations are explained by drainage, as at lower levels the opportunities for contamination were much greater. Acland also gave a full description of the meteorological conditions during the outbreaks, with elaborate diagrams, as part of his attempt to correlate weather with disease. "The publication of the cholera memoir," said J. B. Atlay, "raised Acland from the position of a country physician in good practice to that of an authority on sanitary and hygienic questions of acknowledged repute, not only at home, but on the continent, and in Canada and the United States."[2]

[1] Acland, H. W., 'Memoir on the cholera at Oxford' (1856), pp. 49–50.
[2] Atlay, J. B., 'Sir Henry Wentworth Acland' (1903), p. 197.

A brief reference should be made to two pioneer health maps. In 1882 Dr. Alfred Haviland produced a *Health-Guide map for Brighton* and in the following year a similar map for Scarborough.[1] The Brighton map, drawn on a scale of 9 inches to 1 mile, showed geology in colour and relief by contours at 25-foot intervals. The most unusual feature of the map was the indication of "aspect" which was shown by arrows and letters. Arrows point in the direction of the slope and letters show the wind point to which the slope was exposed. Wind charts and climatic statistics

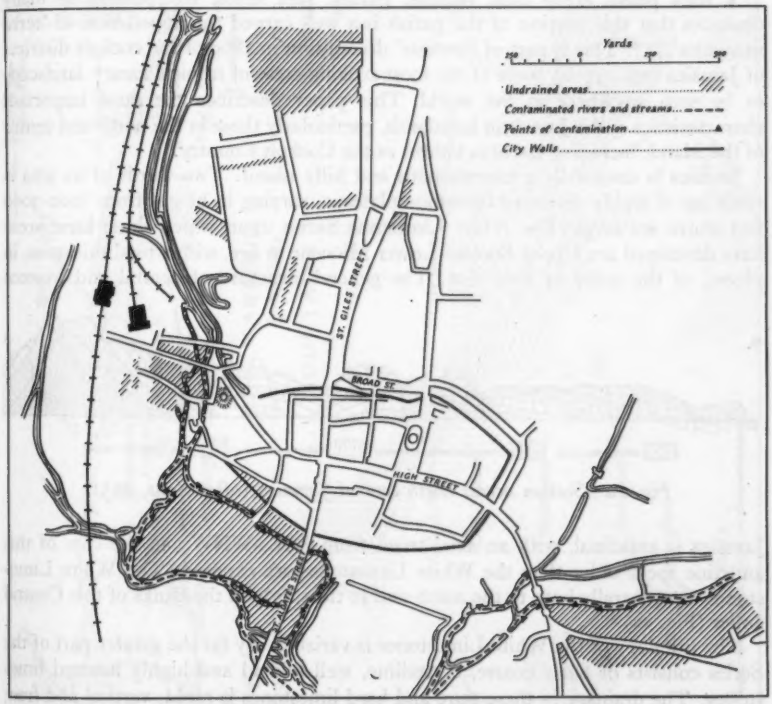

Fig. 11. H. W. Acland's map of undrained districts in Oxford 1854 (1856)

fill the borders of the map. The object of these two maps was to indicate the varying merits of different parts of the towns concerned in the matter of health.

The writer is indebted to the following for much help and advice in the preparation of this paper: Dr. E. Ashworth Underwood of the Wellcome Historical Medical Museum; Professor Helmut J. Jusatz, M.D., of the Geomedical Research Unit of the University of Heidelberg; Dr. Helen M. Wallis of the Map Room of the British Museum; E. J. S. Parsons of the Map Room of the Bodleian; Dr. Elisabeth Rech of Bonn; J. S. Weiner, Reader in Physical Anthropology in the University of Oxford; and J. C. Riddell, City Engineer and Surveyor of the City of Oxford.

[1] Haviland, A., 'Scarborough as a health resort: its physical geography, geology, climate and vital statistics with a health-guide map' (1883).

THE KARSTLANDS OF JAMAICA

M. M. SWEETING

"THE ROUGH AND uneven surface of the country . . . renders it quite impassable; high peaks, steep hills, ravines, gullies, sink holes, etc. present so many obstacles that this portion of the parish has well earned the appellation of 'terra incognita'."[1] * This is part of Sawkins' description in 1869 of the cockpit districts of Jamaica (pp. 195–6), some of the most striking areas of tropical karst† landscape to be seen anywhere in the world. This paper describes the most important characteristics of the Jamaican karstlands, particularly those in the north and centre of the island, including the area known as the Cockpit Country.

Jamaica is essentially a mountainous and hilly island. Two-thirds of its area is made up of highly dissected limestone plateaus, varying in height from 1000–3000 feet above sea level. The White Limestone Series upon which these karst areas have developed are Upper Eocene–Lower Miocene in age, with a total thickness, in places, of the order of 2000 feet. The general structure of central and western

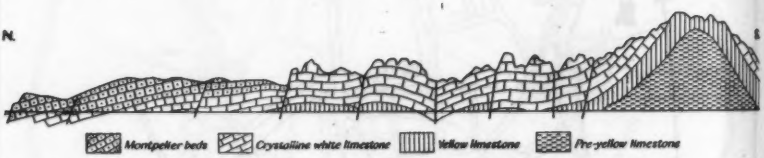

Fig. 1a. Section across north central Jamaica (after Zans, 1951)

Jamaica is anticlinal, with an axial trend from ESE.–WNW.; in the core of this anticline rocks older than the White Limestones are exposed. The White Limestones dip generally both to the north and to the south off the flanks of this Central Inlier (Fig. 1a).[2]

The lithology of the White Limestones is variable. By far the greater part of the Series consists of fairly coarse, crystalline, well-jointed and highly fissured limestones. The drainage in these pure and hard limestones is rapid, vertical and free; "vertical erosion" is predominant. Certain of the White Limestone Series are, however, of a semi-permeable, chalky or marly facies and contain abundant flint nodules; these beds are known as the Montpelier Beds and they occur in particular along the northern coastal zone, where they are normally separated from the crystalline facies by the Duanvale Fault Zone (Fig. 1). ‡ The Montpelier Beds form a semi-pervious stratum in which water circulation occurs only along the major

* See list of references at the end.

† The term "karstland" has now passed into general use both in European and American geographical writing. It is used to denote a region of massive limestone or dolomite where the evolution of the relief is dependant upon chemical erosion, *i.e.* solution, as the dominant process in land form development and where, as a result, surface drainage becomes diverted into underground channels. The word "Karst" is the German form of the Slovene word "Kras," meaning a bleak, waterless place and is the name given to the country inland from Trieste.

‡ The Montpelier Beds are usually considered to represent an offshore facies of the crystalline White Limestones.[3]

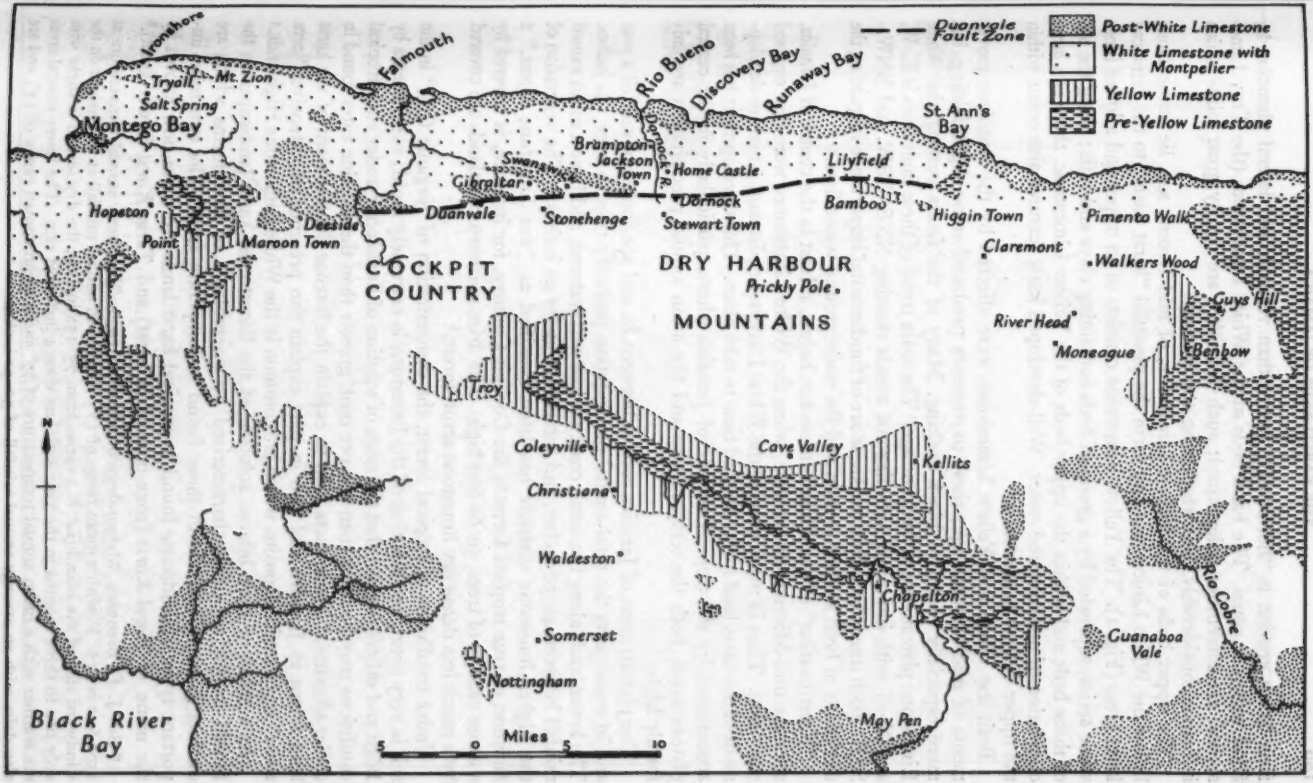

Fig. 1. Geological map of north central Jamaica (after Hose and Versey, 1956)

fault lines; erosion is "horizontal" rather than vertical, and lateral planation by flood waters is usual. The basal beds of the White Limestones (the Troy Limestones) are sometimes dolomitized; such dolomites are cut by great joints which influence considerably their weathering and erosion.[3]

The upper beds of the Yellow Limestone, of mid-Eocene age, lie immediately below the White Limestones and form the essential "karst basis" to the Jamaican karst areas (Fig. 1). The Yellow Limestone consists of an upper and a lower limestone series, separated by a group of beds containing clays and tuffs; along the top of these beds and within the upper beds of the Yellow Limestone, there is a large circulation of underground water. Well-developed karst features also occur within the upper Yellow Limestones.[4]

Both the White and Yellow Limestones were affected by the Antillean movements of mid-Miocene age; these movements produced some slight folding, but more especially extensive block faulting. Many of the faults cutting the White Limestone plateaus are of Miocene age. The main trend of these fault lines is E.–W. and N.–S. with important sub-diagonal trends running NNE.–SSW. and NNW.–SSE. Such lines of tectonic weakness are of fundamental importance in guiding the directions of both surface erosion and the underground water flow.[4, 5]

"Karstification" of the White Limestones began, at least in the centre of Jamaica, after the mid-Miocene movements, when the White Limestones were first exposed to erosion. Thus in many parts of the White Limestone plateaus, a mature development of the karst land forms has had time to take place. This development has been accentuated by the tropical climate of Jamaica where, particularly in the central plateau areas, both the temperatures and the mean annual precipitation are uniformly high.

The plateau areas of Jamaica receive between 80 and 100 inches of rainfall a year and in some parts the total annual precipitation probably rises to over 150 inches. The lower lands along the north coast are less well watered, and have a mean annual rainfall between 40–50 inches, and sometimes under 40 inches.* The vegetation of the higher limestone districts has been classified as "wet limestone forest," a faciation of true tropical forest[6]; the Cockpit Country, for instance, is covered by a dense canopy of trees, 50–60 feet high. The drier northern coastlands are covered by a much less dense dry limestone scrub forest.[6]

Under conditions of tropical forest, the concentration of "organic CO_2" in the soil is very great, and solution of the limestone is extremely rapid; experiments by Bögli and others suggest that the rates of solution of limestones under such tropical conditions may be more than 400 per cent. greater than the solution rates found in cooler climates.[7] These facts help to explain the intense development of the karst land forms in Jamaica and also in part explain the presence of extensive "terra rossa" and bauxite deposits, which are common in the White Limestone Highlands.[4]

As a result of such intense solution of the limestones, karst landscapes in the humid tropics are often characterized by assemblages of land forms which are distinct in many ways from those found in temperate areas. The two most important types of landscape found in tropical karst lands are those now known by the name of *Kegel Karst* (cone or cockpit karst) and *Turm Karst* (tower karst).[8]

* See J. F. Brennan, 'Meteorology of Jamaica,' 1936. The mean annual temperature at 1500 feet is 73·6° F. with a mean range of 13°. The mean annual rainfall at this height on the windward side of the island (*i.e.* N.) varies from 75–150 inches; the dry season is slight with only two to three months in the year with less than 4 inches of rain. The lower coastal areas are warmer with a mean annual temperature of 77° and a mean annual range of 15°, and are also drier with an average annual rainfall of 30–50 inches.

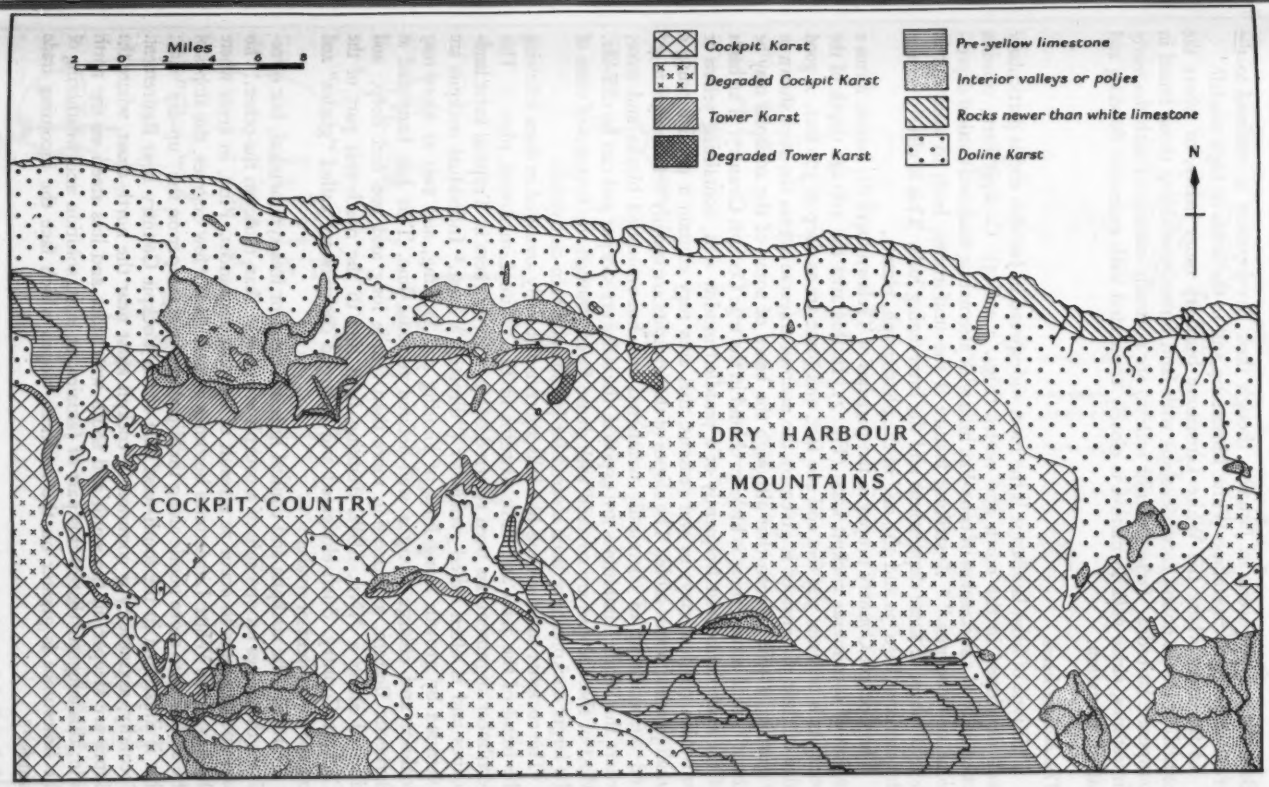

Fig. 2. Karst land forms, north central Jamaica

Both these types occur in Jamaica, though their development is confined to the areas of the hard crystalline White Limestone and to the areas of high rainfall.

In the areas where the White Limestone beds are more marly, or where the rainfall is low, a doline karst develops with land forms resembling those found in temperate latitudes. *Poljes* (interior valleys) are normally associated with the marly limestones, since *polje* formation is closely connected with extensive flooding and lateral planation.

The cockpit karst

This type of karst landscape is the most widespread in Jamaica and is particularly well developed in the north and centre (Figs. 2 and 3). Cockpit karst consists essentially of a succession of cone-like hills with alternating enclosed conical depressions or "cockpits." * A striking feature is the uniformity, both in area and in height range, of these depressions and the intervening hills. This is clearly seen in the sections (Figs. 3a and 3b), and in the photograph, plate 1.

The Cockpit Country proper in the parishes of Trelawny and St. James, forms a region of continuous cockpit karst (Fig. 2). In this area the average depth of the cockpits is between 300 feet and 400 feet, and some are as deep as 500 feet. A good idea of their dimensions is given by the aneroid traverse across the area shown in Figure 3; it will be seen that although the bases of some of the cockpits may be about $^1/_4$ mile across, there is little level land in the true Cockpit Country. The bases of the cockpits consist frequently of a puddled muddy area, containing yellow or brownish residual clay; in wet seasons, this area may contain a pond forming a small perched water-table. The slopes of the cockpits are usually between 30° to 40° and are made up of chemically weathered and honeycombed blocks and scree; where the White Limestones are exposed, the sides are steeper and can be cliff-like. Most of these slopes are covered with dense forest, though the bottoms of some of the larger cockpits have been cleared for banana and yam cultivation.

The cockpits and the cone-like hills are conspicuously arranged in lines following the trend of the joint and fault patterns in the White Limestones, plate 1. This rectilinear alignment has been referred to by many workers in Tropical karst landscapes and is often called *gerichteter* ("directed") karst.[8] Individual cockpits are extended by growth along lines of jointing and faulting, and two or more may coalesce and enlarge along a well-defined tectonic line. This has happened at Barbecue Bottom, a depression more than 1 mile long and 400 feet deep, and situated along a NNE.–SSW.-trending fault line in the north-east part of the Cockpit Country. Such elongated and enlarged cockpits are called "glades" and are the equivalent of uvalas.[5, 9]

Normally the cockpits and conical hills are more or less symmetrical, but sometimes the slopes on one side of a cockpit are steeper than those on the other. This asymmetry seems to occur as a result of two circumstances. First, in areas where the dip of the White Limestones becomes greater than a few degrees, the slopes of the cockpits are more gentle along the dip slopes and steeper on the "up-dip" side; this is illustrated in the south-west part of the Cockpit Country near Retirement. Secondly, asymmetry is common in cockpit karst near the north coast, where the slopes are steeper on the south and south-west sides and less steep on the north side; this suggests that in this part of Jamaica, at least, solution and weathering of the limestones is greater on the northern slopes which face the incoming trade winds.[10]

* So called for their resemblance to the arenas for cockfighting.

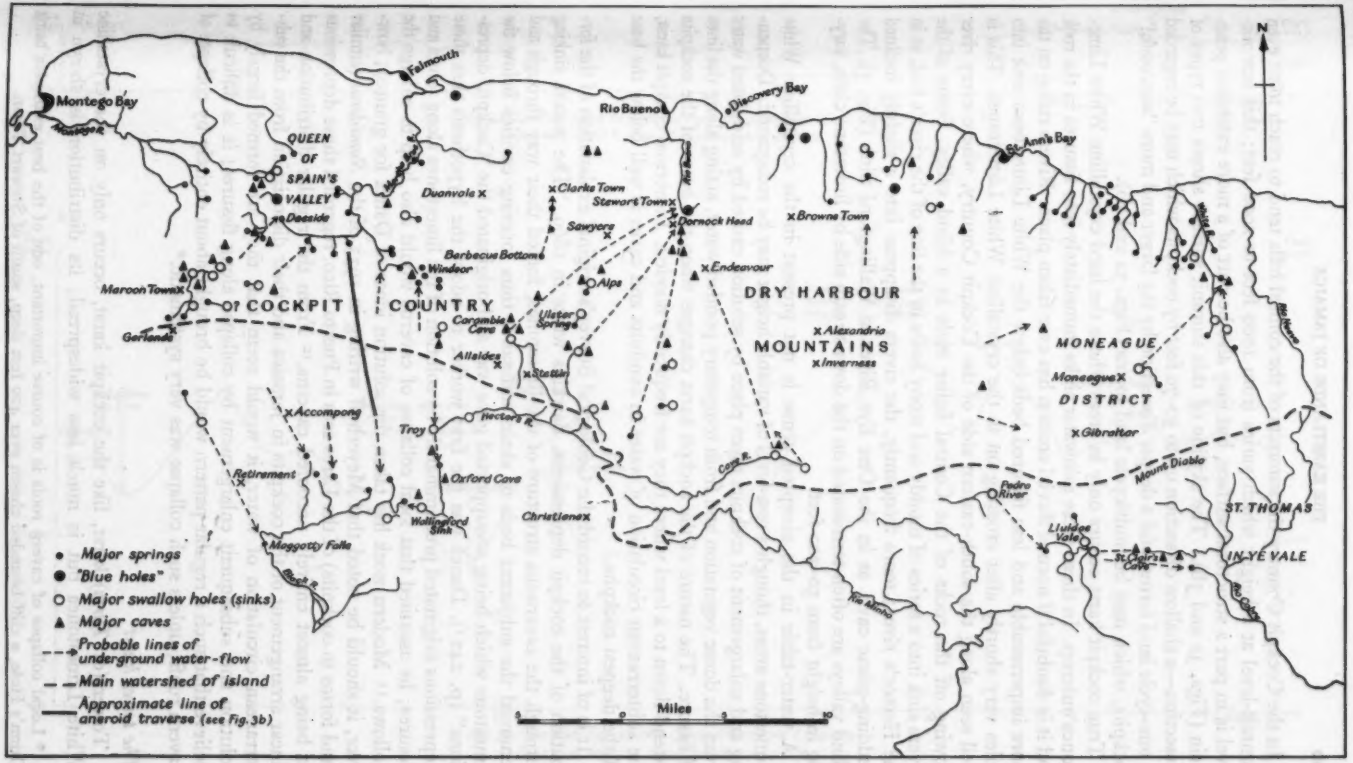

Fig. 3. Main features of the hydrology, north central Jamaica

In the Cockpit Country the summits of the conical hills tend to reach to an even summit-level at a height which varies from 1000 feet to 2000 feet; this summit-level is in part a structural surface, but may also be part of a more extensive peneplain (Figs. 3a and 3b).[5] The skyline of this summit surface shows two types of dissection—a shallow dissection up to 50–70 feet by cockpits which may be regarded as one-cycle land forms, and a deeper dissection by the larger and more "successful" cockpits, which may be multicycle land forms (Figs. 3a and 3b).

True cockpit karst occurs only in areas where the hard crystalline White Limestones outcrop. In these areas rainwater sinks immediately into fissures in the rock and it is doubtful if normal fluvial erosion has ever taken place. Rivers rising on the more impermeable and less fissured beds below the White Limestones sink into holes very shortly after crossing on to the crystalline White Limestones. This is well seen along the south-eastern side of the Cockpit Country, where every river flowing off the rocks of the Central Inlier ends in a blind valley. Some of the rivers sink into a series of muddy and stony holes in the line of the river's bed, as in the Hector's river; more frequently, the rivers disappear into a slightly inclined bedding-plane cave, as in the One Eye River at Wallingford Sink (Fig. 3). The blind valleys are often terminated on the downstream side by limestone cliffs, varying in height from 50–200 feet.

A water-table in the accepted sense is not present in the crystalline White Limestone areas, though a rest-level of variable height may be recognized. Deepening and enlargement of cockpits takes place by solution caused by acidulated water from the dense vegetation and from temporary ponded water, acting along the lines of fissure. The nature of the cockpit karst changes when the bases of the cockpits extend down to a level where they are frequently flooded. In normal cockpit karst, the subterranean circulation of water in conduits and caves is well below the base of the deepest cockpits.[5]

It is of interest to record the Geological Survey's original explanation of the formation of the cockpit depressions. Sawkins wrote in 1869, "The waters sinking through the cavernous structure of the limestones, forced their way through and removed the subjacent beds of shale and sand, thus forming cavities below the limestone which being unsupported gave way and originated the 'Cockpit' depressions" (p. 242[1]). Daneš was the first worker to adopt the hypothesis that these depressions originated predominantly by solution of the limestones along joints and fissures; he assumed that local collapse of caverns would also help to enlarge the hollows.[11] Modern work has taken the solution ideas of Daneš for granted; however, it should be noted that Meyerhoff writing in 1933 of the *Sumideros* (similar land forms to cockpits) of the Lares area in Puerto Rico, regarded these depressions as being almost entirely unroofed caverns.[12] From the regular distribution and linear arrangement of the cockpits in Jamaica and their dissociation from the subterranean circulation of water, it would seem that they are formed largely by solution and subsequent enlargement by collapse along fissures; it is difficult to believe that such a regular pattern would be brought about entirely by collapse of cavern roofs, unless such collapse was very systematic.*

The tower karst

Tower (or *Turm*) karst, like the cockpit karst, occurs only on the crystalline White Limestones but is much less widespread; its distribution is shown in

* Local collapse of cavern roofs is of course important, one of the best examples being Dunn's Hole, a cliff-bounded chasm over 400 feet deep, south of Stewart Town.

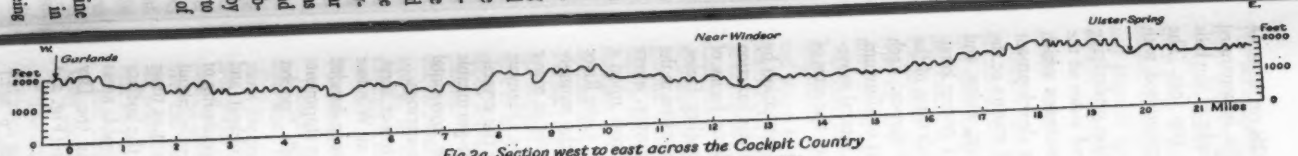

Fig.3a. Section west to east across the Cockpit Country
Based on D.O.S. map of Jamaica, on 1:50,000

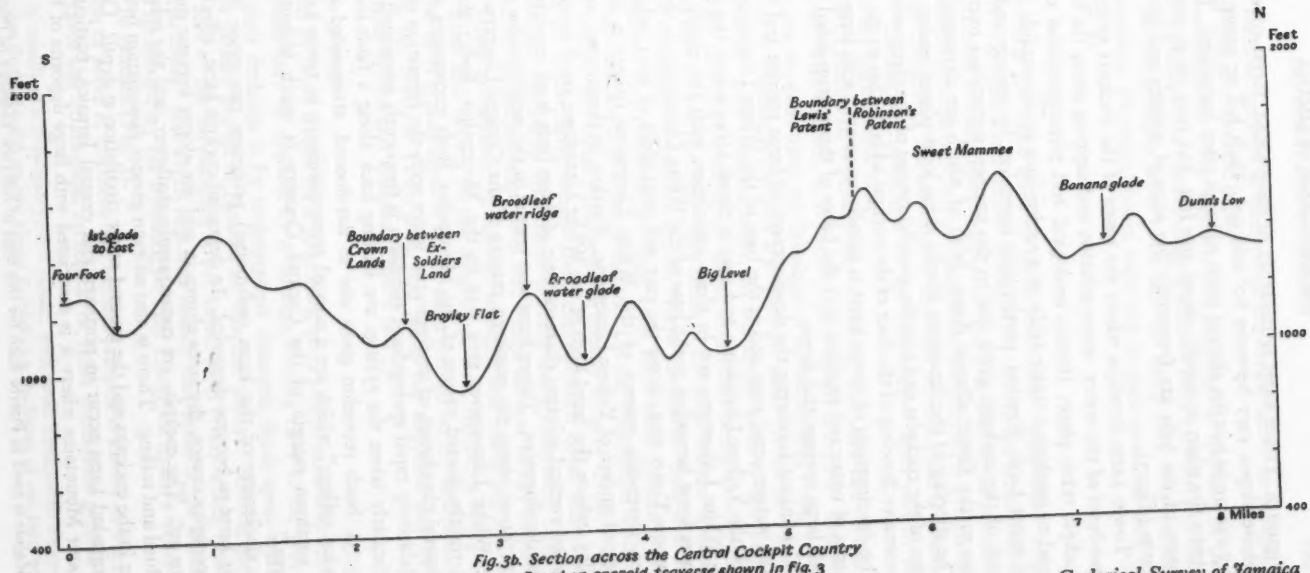

Fig.3b. Section across the Central Cockpit Country
Based on aneroid traverse shown in Fig. 3

Geological Survey of Jamaica

Figures 3a and 3b

Figure 2. Tower karst is made up of steep-sided, forest-covered hills or *mogotes*[6] whose slopes vary between 60° and 90°. Each hill or group of hills is separated by a more or less flat alluvial plain which is often inundated. The height of the hills above the plain is usually about 300 feet, but may be as much as 500 feet. The bases of the hills are frequently the sites of springs and are honeycombed with caves (Fig. 3).

Tower karst develops where the bases of the cockpits extend to the underlying rest-level of the water, when solution and sapping along the base and sides of the cockpit takes place. Hence, geological and physiographical circumstances which tend to produce a water-table or a spring-line are favourable for the development of tower karst. Erosion, particularly corrosion, by springs and flood waters at the base of the cockpits gives rise to the steeper, sometimes overhanging, sides, and also to the flatter alluvial floors, both of which are characteristic of tower karst. The slipping of the limestone blocks along joint-planes assists the widening of the base of the cockpits and also the parallel retreat of the steep-sided hill-slopes. Each successive flooding of the floor of the cockpit adds further to the deposit of alluvium. The development of tower karst is usually associated with large-scale lateral movements of water and explains why the bases of these steep-sided hills are the sites of both large springs and caves.

Conditions favouring the development of large springs and lateral planation by flood waters occur near and at the base of the White Limestones at their junction with the Yellow Limestone and also in those areas where the crystalline facies of the White Limestone are in close association with the marly Montpelier facies. Tower karst formation at the base of the White Limestones is well illustrated in the Maroon Town area, along the east and west sides of the Cockpit Country, where steep tower-like masses of the White Limestone (plates 2 and 3) rest upon a stripped surface of Yellow Limestone. Further, in those areas, as in the Cave River Valley, where the basal beds of the White Limestone are dolomitized, the strongly marked vertical jointing characteristic of those beds is an important factor in tower karst development. Tower karst also occurs in the neighbourhood of the Duanvale Fault Zone, along the northern margin of the Cockpit Country. Here the crystalline White Limestones give way to the Montpelier Beds; the semi-permeable and tightly-jointed nature of the Montpelier Beds encourages a more horizontal or lateral circulation of underground water with the formation of large springs.

Relatively rapid spring-head recession is frequently associated with tower karst, particularly when the springs are cutting back along a fault-line, as at Windsor (Fig. 3). Such recession gives rise to flat-floored, steep-sided and steep-headed "pocket valleys" which are a normal accompaniment to tower karst development; the northern margin of the Cockpit Country is much indented with "pocket valleys."

A slackening of the karst (solutional) processes can cause both cockpit and tower karst to become degraded. In degraded cockpit karst, effective deepening of the cockpits ceases, the sides slump in and the slopes become more gentle, about 20° to 30°. The cockpits are consequently shallower, and the relief becomes more subdued and rolling. There is also an even greater dissociation between the surface water in the cockpits and the ground water circulation at depth. Considerable areas of degraded karst occur in northern and central Jamaica, particularly in the Dry Harbour Mountains where it is associated with large deposits of bauxite (Fig. 2).[4]

[6] *Mogote* is used in Puerto Rico for this type of hill (see 'Geology of Puerto Rico,' p. 257.)

The accumulation of residual material is clearly one important factor in bringing about the formation of degraded cockpit karst.

Tower karst becomes degraded when solution and planation at the foot of the steep hills is reduced, particularly if the flooding of alluvial land between the hills ceases. Slumping of the steep slopes takes place and the sharp nick between hill and alluvial floor disappears. Degraded tower karst can be seen near Sawyers, in eastern Trelawny (Fig. 2).

Doline karst

Doline karst resembling the karst areas of Istria and other "temperate" areas occurs in certain parts of northern and central Jamaica (Fig. 2). In the areas studied two main factors contribute towards its development; the first, and by far the more important, is the presence of a marly or impure limestone, the second, is a relatively low annual rainfall (30–50 inches). Doline karst is therefore an important landscape type on the Yellow Limestone Series and on the Montpelier Beds and in the drier areas along the northern coastal zone.

Doline karst usually consists of relatively flat or rolling and park-like country, irregularly interspersed with dolines; it is usually only lightly forested. The size and shape of the dolines depends upon the lithology of the underlying rock. In the lower beds of the Yellow Limestone, dolines are relatively small (about 50–150 feet in diameter) and shallow, with slumped sides. In the upper beds of the Yellow Limestone, dolines are large and often steep-sided, sometimes being over 400 feet in diameter and they may be 100 feet deep; as a result of the large volume of underground water which circulates within the upper Yellow Limestone beds and their highly cavernous nature, many dolines in these beds have been formed by the collapse of cavern roofs and are true *einsturz-dolinen*. On the Montpelier Beds, the dolines are usually shallow and open V-shaped, the *trichter* form of Cvijič.[9]

The largest area of doline karst occurs along the northern coast where both lithological and climatic conditions contribute towards its development (Fig. 2); here it is developed on the Montpelier Beds and forms an area of dry limestone scrub forest with "trees accustomed to intense sunlight and fairly dry soil conditions."[6] Doline karst also occurs in the Moneague area, despite a fairly high annual rainfall. The most typical areas of doline karst formed on the Yellow Limestones, is found in the Maroon Town area, and along the southern side of the Cockpit Country near Stettin and Allsides (Figs. 2 and 3).

The interior valleys or poljes

Lateral planation by flood waters on a large scale gives rise to extensive areas of alluvium; these areas may be drained by a through-flowing river to the sea, but more frequently their drainage is by underground channels. Such areas are then true *poljes* and are usually known in Jamaica as "interior valleys." Strong springs issuing from the foot of the surrounding tower karst, form rivers which meander over the flat alluvial floors* and which sink into muddy sink-holes in the middle of the *poljes*; this is illustrated by the hydrology of the Queen of Spain's valley, the best known *polje* in Jamaica (Fig. 3).

The distribution of *poljes* in northern and central Jamaica is shown in Figure 2. They occur wherever the lithological, structural or relief conditions permit flood

* The alluvium is usually of a brownish-yellow colour, with small ferruginous concretions and from 10 to 25 feet thick. In one or two places it reaches a thickness of 100 feet, when it grades into a true terra rossa.[1]

waters to collect and where rapid drainage away is impeded. Thus *polje* development is conspicuous along the northern margin of the Cockpit Country where the nature of the Montpelier Beds encourages the lateral movement of water; a series of E.–W.-trending *poljes* at heights varying from 290 feet to 600 feet above sea level, therefore occurs along the northern side of the Duanvale Fault System. Small *poljes* also develop at the junction of the Yellow Limestones with the White Limestones where flood-waters are ponded back after heavy rains and are unable to drain away. The Cave River Valley (at over 1800 feet) and the Troy Valley (at 1500 feet) *poljes* are examples. In the Moneague area the synclinal structure of the White Limestone beds and the basin-like nature of the relief have together led to the large-scale accumulation of underground water; wide fluctuations in the level of this underground water take place and produce intermittent flooding and *polje* conditions. At Lluidas Vale (1250 feet), *polje* development is due both to the faulted structure of the White Limestones and to close proximity of the rocks of the Central Inlier from which flood-waters descend (plate 4).

All these *poljes* occur at varying heights above sea level, and their formation is essentially controlled by the local water-table at the time of flood in a given area, rather than by the existence of any general water-table or base-level. This local surface or base-level towards which the flood-waters drain has been called the level of the *vorfluter*.[13] *Polje* formation is therefore related to the local geological and hydrological conditions and is independent of and often much higher than the main stratigraphical karst basis.[5] Furthermore the *poljes* do not necessarily form part of any particular stage in a cycle of evolution of the land forms, nor are they necessarily related to any obvious still-stand in the uplift of the island.

Changing hydrological conditions produce changes in the drainage of the *poljes*. Enlargement of underground channels or the development of new channels will facilitate the drainage of a *polje* and reduce the amount of flooding; "drying out" may also be brought about by uplift of the land, for which there is much evidence in Jamaica. Such drained *poljes* occur at various levels, notably at Gibraltar (1250 feet) south of Moneague; it is also possible that the high level plains in the Dry Harbour Mountains, at Alexandria and Inverness (2000 feet) are old *polje* floors, the alluvial deposits of which have now been converted into bauxite.

It will be noticed from Figure 2 that many of the *poljes* are formed along the margins of the areas of well-developed cockpit karst, and are not completely surrounded by the crystalline White Limestones. Similar marginal *poljes* have been described in Cuba by Lehmann, who regards them as a well-defined type of *polje* (*Randpoljen*).[13]

The circulation of underground water and underground land forms

The hills of the Central Inlier form the main watershed of the island, from which water flows either to the north or south coasts. However, though much of the underground water in the White Limestone areas is derived from streams rising in the Central Inlier, the greater part is believed to be autochthonous in origin and derived from the heavy rainfall of the White Limestone plateau. It is also believed that this large volume of underground water circulates at some considerable depth below the base of the deepest cockpits.[5]

The direction of flow of underground water is controlled first, by the directions of the dip, jointing and faulting within the White Limestones; secondly, by the changes in the lithology of the White Limestones; and thirdly, by the height and relief of the karst basis, the middle and upper beds of the Yellow Limestone.

The pattern of the underground water circulation in the karst areas of Jamaica is relatively simple, free and unconfined, particularly when compared with the complex patterns of water flow to be found in limestone areas in the British Isles and in Western Europe. The actual water flow is also comparatively rapid, as is indicated by the swift rise of springs after rains in the highland areas. Directions of flow are remarkably easy to predict; the main directions are given in Figure 3.* This figure further indicates that water travels fairly long distances underground; for instance, water which sinks on the northern side of the Central Inlier, issues in springs near the north coast—over 10–14 miles away (Fig. 3). The gradients of the water flow are relatively gentle, varying from 1 : 30 to 1 : 60. All these features point to the underground channels being well developed and of large size, a fact which is supported by the large caves of the area. Zans has referred to the underground water circulation beneath the Cockpit Country as resembling that of a "canalization system beneath a city."[5] These facts are in accord with the concept of a mature karst development.

Underground water issues in large springs † along the margins of the crystalline White Limestone areas, where these beds are in contact with less fissured and less permeable strata and where tower karst is important. Springs occur, in particular, in association with fault lines. Hence, many springs occur along the Duanvale Fault Zone. They are also found where newer beds, like the Coastal Limestone Formations (Pliocene) or recent alluvium, outcrop against the White Limestones.

The distribution of the chief springs in northern and central Jamaica are shown in Figure 2. There are three main types of spring.[5] These are:

(*a*) *Normal springs*, which issue from local underground reservoirs and are not under any great hydrostatic pressure. They show great seasonal variation in volume and may dry up altogether in the dry season. Such springs tend to be more muddy than similar limestone springs in temperate regions. There are numerous examples, a characteristic one being at Deeside, on the south side of the Queen of Spain's valley at 290 feet; this has a maximum flow of about 30 cu. ft. per sec. in a normal rainy season, dropping in the dry season "to only a few cubic feet."[14]

(*b*) "*Boiling springs*." These are vauclusian or fountain springs where the water literally "boils" up to the surface under great hydrostatic pressure, particularly in the wet season. The volume of these springs is variable, but they do not usually dry up. Two of the best examples are Fontabelle spring, 300 feet, near Windsor (maximum discharge 100 cu. ft. per sec.) and the Potosi "Water Boil" in the Martha Brae river, at 80–86 feet (discharge 60 cu. ft. per sec.).[14]

(*c*) "*Blue Holes*" are quiet upwellings of large volumes of water, usually through circular pipes over 100 feet deep in the limestone; they are normally placid with no ebullience and no apparent current until the water overflows. The water in the rising appears as a bright blue-green colour, possibly due to the presence of calcareous algae. The water rises under considerable hydrostatic head and because of their immense volume, these springs are the most impressive in the island. They vary only very slightly in volume and must be fed by vast underground reservoirs. One of the best known of the blue holes forms the head of the Dornock river near Stewart Town, at 320 feet (discharge not measured).[15]

* Few tests of water-flow have yet been done using fluorescein or other methods, but it is not expected that the directions given in Figure 3 will be significantly modified by such tests.

† It is said that the name "*Jamaica*" is derived, through Spanish sources, from an Arawak word, which may mean "a country abounding in springs." F. Cundall, 'Place-Names of Jamaica,' revised by P. M. Sherlock, 1939.

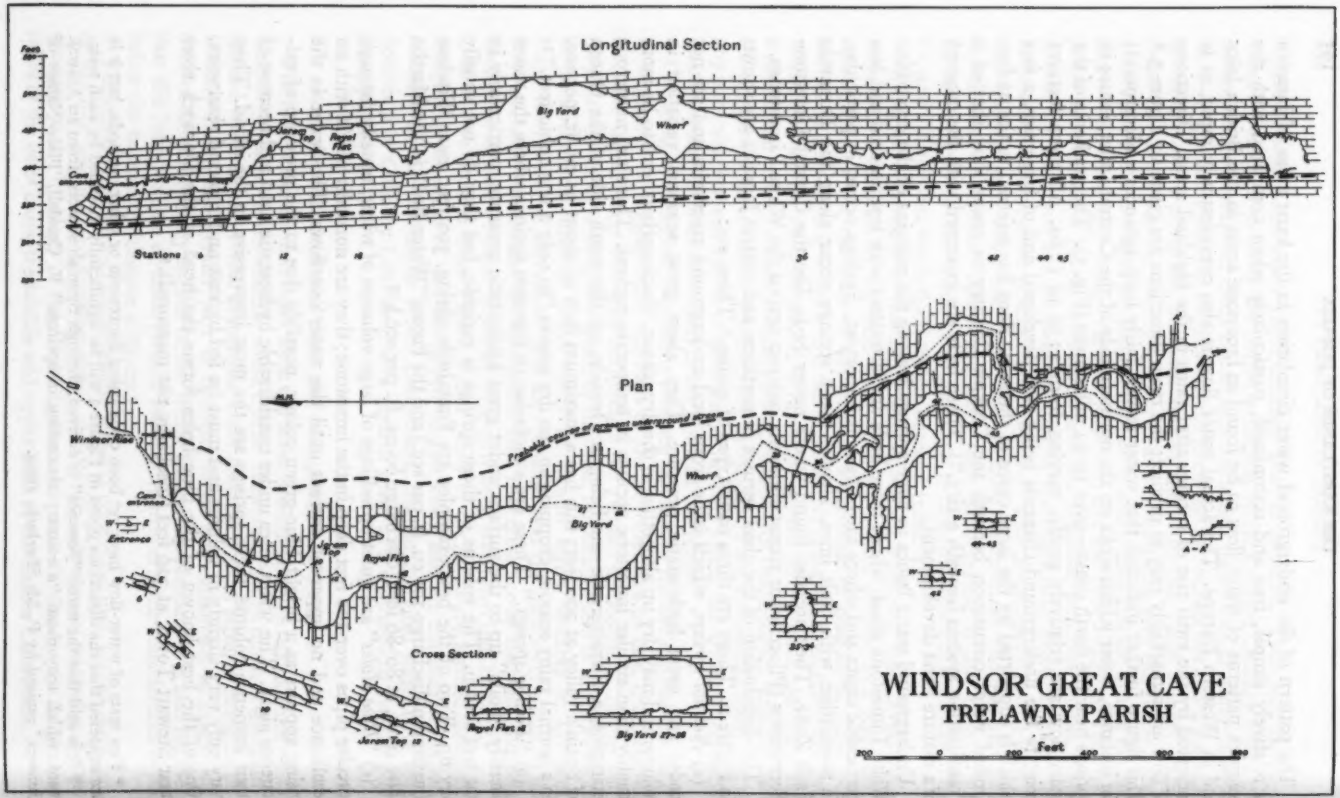

Figure 4.

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It is well known that some of the water which circulates within the limestones, appears in submarine springs off the north coast, particularly in the neighbourhood of the Rio Bueno[1, 5]

The caves of the White Limestone areas are intimately associated with this pattern of underground water flow. Caves occur within the crystalline beds of the White Limestone, and also in the upper beds of the Yellow Limestone; they are unknown in the Montpelier Beds. As a result of the dense vegetation and large deposits of terra rossa and bauxite, many caves are inaccessible. The known caves occur in two main situations: first, at the base of the White Limestones and in the top beds of the Yellow Limestones; secondly, at the zone of contact of the Montpelier Beds with the crystalline White Limestones. All the caves investigated at present, lie well above the water-table or are only periodically flooded.

As would be expected from the large volume of underground water and the nature of its flow, caves are relatively large in size and simple in type. This is shown in Figure 4, which is a survey of Windsor Cave, one of the best explored caves in Jamaica and is typical of those situated along the zone of contact between the Montpelier Beds and the crystalline Limestones. Cave passages are long (explored as far as 2–3 miles), with tunnel-like cross sections, often 70–80 feet high and 100–120 feet wide. Roof falls are fairly common, and there are frequent accumulations of limestone blocks in the passages; this means that the profiles of the cave floors are often undulating (Fig. 4). However, the overall gradient of the cave floors resembles that of the gradient of the underground water flow, *i.e.* between 1 : 30 and 1 : 60. Gently undulating or only gently inclined passages predominate, vertical passages or pot-holes being comparatively rare. The cave pattern is relatively unbranching, consisting of one major trunk passage and very few side passages. The directions of the caves are similar to those of the general underground water flow of the island, and are controlled by the dip of the beds, and the lines of jointing and faulting. Caves situated at the junction of the Yellow and White Limestones are sometimes less simple in plan, as at Carambie Cave where the pattern is more nearly a network of large chambers. This more complex pattern may be due in part to the more frequent collapse of limestone blocks, which is common at the Yellow-White Limestone junction.

Nearly all the caves bear signs of fluting and pocketing by water.[16] Such fluting indicates the former presence of large volumes of water under considerable hydrostatic pressure. In Windsor Cave and in many others, the seasonal variations in the level of the water are at least as much as 70 feet. Under such conditions the caves are filled to the roofs and there is considerable erosion by the swirl and pressure of flood water; at the end of Windsor Cave, for instance, there exist great swirl meanders (50–100 yards in diameter) cut to the roof by flood waters, indicating the great erosive power, both chemical and mechanical, of the underground water.

"Dry Caves," now drained and well above the water-table, tend to occur in groups, along the north and south margins of the Cockpit Country and the Dry Harbour Mountains.[5] Such caves probably represent the sites of former springs and underground channels and are related to the level of former *vorfluter* and high-level circulation of underground water. This close relationship of the caves to the general underground water circulation, is of interest from the point of view of theoretical ideas on cavern development.[16] Not enough is known about the denudation chronology of Jamaica to ascertain whether the groups of caves are in any way determined by the heights of former base-levels.

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Conclusions

It has been shown that there is considerable variation in the karst land forms of northern and central Jamaica, depending in particular upon variations in the lithology and structure of the limestones, but also upon differences in relief and rainfall. Under conditions of high temperature and high rainfall in a tropical region, the cockpit karst comes as near to being an assemblage of land forms, produced by one geomorphological process (*i.e.* solution) as is possible. Even cockpit karst does not, however, form entirely at random under these climatic conditions and its occurrence is determined by the presence of crystalline White Limestones. The pattern and alignment of the individual cockpits is further controlled by joints and fissures in the limestones. This structural control is dominant from the beginning, a point which has been stressed by recent work in the tropical limestone areas.[8, 17]

Normally, in the cockpit karst, the rest-level of the underlying water sinks considerably below the base of the deepest cockpits. The cockpits then deepen and enlarge only relatively slowly; frequently their sides slump in and their relief flattens and becomes degraded, as has occurred in the Dry Harbour Mountains. This cycle of land form development is therefore somewhat different from that worked out by Daneš and by Grund.[11, 18] Their ideas assumed that the bases of the cockpits were continuously or for a long period of time in association with the rest-level of the water; under these circumstances lateral planation would be encouraged and cockpit karst might be replaced by a karst with *poljes*. In Jamaica, these conditions are usually brought about by the presence of a relatively marly limestone. The distribution of *poljes* as shown in Figure 2, and their close association with the Montpelier Beds, suggests that the *poljes* form at the beginning of any sequence of land form development on these beds and that their subsequent history is solely that of enlargement. The evolution of land forms by stages from a cockpit karst through to a karst with *poljes*, as deduced by Daneš and Grund, is therefore very rare; normally, cockpit karst is replaced abruptly by karst with *poljes* along a well-defined structural line. Thus the more accurate geological knowledge of Jamaica, which we now possess, shows that Daneš and Grund made a generalization about karst land form development, which is not now borne out by the facts, and relates only to special conditions.

Acknowledgements

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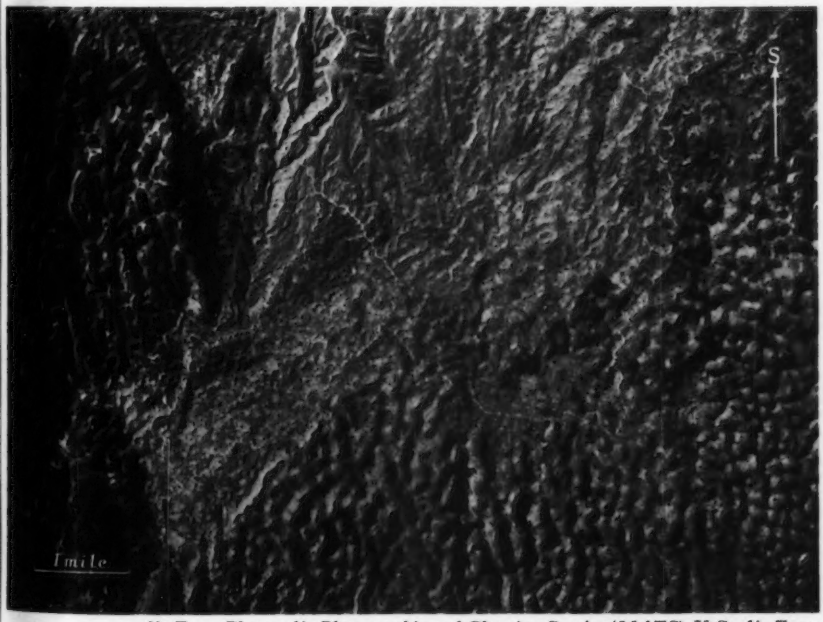
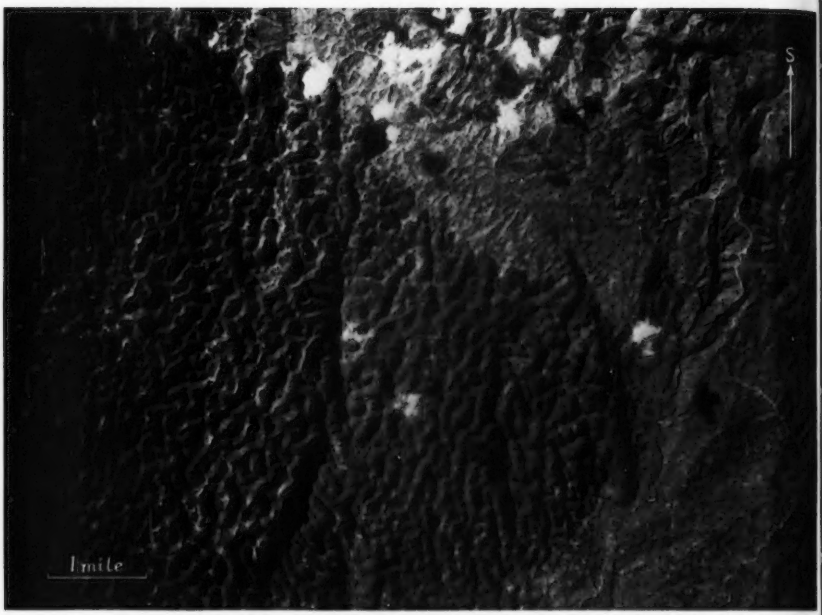
Air Force Photo: Air Photographic and Charting Service (MATS) U.S. Air Force

1. Central part of the Cockpit Country showing alignment of cockpits



Air Force Photo: Air Photographic and Charting Service (MATS) U.S. Air Force

2. East margin of the Cockpit Country, showing well developed tower karst near Burnt Hill and Ulster Spring



Air Force Photo: Air Photographic and Charting Service (MATS) U.S. Air Force

3. East margin of the Cockpit Country near Wait-a-Bit, showing contrast with the Central Inlier

Air Force Photo: Air Photographic and Charting Service (MATS) U.S. Air Force

4. Polje of Lluidas Vale with both cockpit and tower karst, and part of the Central Inlier

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THE OXFORD UNIVERSITY EXPEDITION TO SOCOTRA

DOUGLAS BOTTING

SOCOTRA LIES IN the Indian Ocean, roughly 150 miles east-north-east of Cape Guardafui and 400 miles from the nearest administrative centre, Mukalla, in the Eastern Aden Protectorate (of which Socotra is a part). It is mostly mountainous along its axis, the granite peaks of the Haggier Massif rising nearly 5000 feet out of an overall limestone plateau which averages about 1500 feet in height. Along 30 miles of the south coast runs a flat and barren plain of sand-dunes and lava rock, backed by the steep scarps of the plateau. To the north are two other coastal plains, the northern coastal plain, and Hadibo plain at the edge of which is situated the capital of the island. The mountains and plateaus are split by numerous gorges, which are normally dry but sometimes turn to raging torrents during the rainy months of the north-east monsoon between November and March. The largest wadi system—the wadi Gow–wadi Fahr—traverses the island east of the Hadibo plain, the most favourable part of the island for cultivation, for elsewhere it is mostly barren and waterless. The population of the island probably does not total more than 8000, of which half live in numerous small settlements along the north coast, engaged in fishing and trade, while the other half live in the mountains herding cattle and goats—these are the aboriginal bedouin, a small and primitive community about which little was known until quite recently. No Europeans live on Socotra and it is quite undeveloped.

It seems at first glance surprising that Socotra Island should be so little known generally and so rarely visited, for it lies right on the main shipping route from Suez to India. Although often glimpsed from ships making their way east the island is only normally visited by an occasional officer of the Aden Protectorate Government during the course of his administrative duties. The reasons for this neglect are not far to find. Socotra has no natural harbours and during the period of the violent south-west monsoon it is impossible for ships to anchor off its coast, so that the island is cut off from the outside world. During the favourable season the only ships calling there are Indian and Arabian trading dhows, and the island possesses no natural resources likely to attract European trading companies or investors. Furthermore, having contrived to get himself on the island the visitor may experience difficulty in obtaining adequate food supplies, for the island is not self-supporting and there is barely enough food to go round the native inhabitants. The high incidence of a variety of diseases, particularly malaria during the periods of the changes of the monsoon (Socotra must be one of the most malarial countries in the world), may make a prolonged stay an uncomfortable one.

Socotra was first explored by Lieutenants Wellsted and Cruttenden of the Indian Navy in 1834, and as a result of their preliminary reports on matters of extraordinary interest to science, the British Association and The Royal Society despatched Professor Bayley Balfour to carry out botanical investigations there in 1880. Afterwards he wrote:

> "What has been done by this expedition is but a fragment of what there is to be accomplished. . . . It happens that on this island within but three weeks' journey from England, there dwells a people whose origin is lost in myth, and

of whose speech the true relations are undetermined, who, according to received reports, having obtained some degree of civilization and embraced Christianity have gone back from their advanced position to the lower state in which we now find them and thus present to us a feature of great interest to the history of mankind. . . . There is now on Sokotra alone a wealth of material for exploration and investigation which would amply reward the work of another expedition."

I have quoted these remarks at length because they still largely apply, in spite of the four expeditions that followed Balfour's in the nineteenth century and in spite of our own reconnaissance expedition of 1956. In 1897 the archaeological discoveries of Theodore Bent gave further indications of the island's important ancient history; in 1898 H. O. Forbes made a large collection of Socotran fauna which still provides the basis of our knowledge of the subject; in the same year members of Count Landberg's South Arabian expedition collected the only data yet available on the Socotri language, while another Austrian, Dr. Kossmat, made a very thorough examination of the geology of Socotra. During the Second World War officers of Aden Protectorate Levy detachments based on the island, particularly Majors Tudor Pole and Spencer Cooke, considerably extended our knowledge of the topography of the island, and after the war Socotra was visited by Colonel I. E. Snell, then British Adviser to the Mahri Sultanate, Mr. George Popov, of the Desert Locust Survey, and Mr. Z. Beydoun of the Iraq Petroleum Company. But in spite of this sporadic work, problems of archaeology, anthropology and language still remained largely unsolved and there was a great need for further research in the fields of botany and zoology.

The Oxford University Expedition of 1956 aimed to carry out a general scientific reconnaissance, continuing in part the work of expeditions in the nineteenth century but also breaking new ground. The party consisted of six men, led by Douglas Botting, who was also responsible for making a motion-picture film about the island and its people, and tape-recordings of their language and music. Peter Shinnie, F.S.A., now Professor of Archaeology at the University College of Ghana, was to make an archaeological survey and excavate when necessary. It was believed that Socotra had been an important entrepôt for trade between the Far East and the Mediterranean between the second century B.C. and the sixth century A.D.; Shinnie hoped to find traces of Roman settlements on the island, and also of early Christian churches dating from the sixth century, the probable time of the bedouins' conversion to Christianity. Dr. Neil Orr and Dr. Richard Lister, in addition to their medical work, would take blood samples from bedouin which would be grouped by the Blood Group Reference Laboratory in London and might afford some clue to the racial origins and affinities of this little known people. Michael Gwynne, assisted by John Weakley (who was also the quartermaster of the expedition, responsible for looking after the three tons of food and equipment), was to collect flora and fauna and make a vegetation survey of parts of the island visited.

Thanks to the generous cooperation of the Royal Air Force the party was able to fly to Socotra in two transport aircraft, landing on the rough natural-surface airstrip near Mouri on 1 August 1956. Shinnie had been held up by bad weather at Asmara on his way out from England by air but fortunately was able to fly to the island in a third aircraft which was bringing the Mahri Sultan of Qishn and Socotra back from his recent pilgrimage to Mecca. Shinnie also brought with him an important item—the expedition cash box, containing a large sum of money all in one-shilling pieces. The currency on Socotra, as in Aden, is now East African, and

notes are not appreciated by the majority of the inhabitants who seem unwilling to barter and, surprisingly, unwilling to bargain in some cases. As the Sultan of Socotra seemed to own most of the camels on the island (the rest being owned by his Wazir, Sheikh Ibrahim bin Khaled) it was only possible to hire them directly from him. He refused to go lower than the extraordinary price of 18 East African shillings per camel per day, a price in keeping with others that had to be paid on the island.

During August 5 and 6 sixty camels shifted three tons of stores from the airstrip to Hadibo, the capital. Socotra generally constitutes bad camel country, and the *'aqaba*—a difficult rocky track beside the sea, traversing a high mountain spur between Qadhub and Hadibo—gave the Socotran camels a fine opportunity to demonstrate how well they had adapted themselves to the exigencies of the country. Although most of them had to be half-loaded, they clambered steadily over everything in their path, only having to be lifted by their neck-ropes and tails when some massive boulder blocked their path. Socotran camels do not, however, have the stamina and thirst-endurance of their Arabian brethren, and have to be watered daily in drier parts of the island. An unusual feature of Socotran camel practice is the false hump designed to elevate baggage and rider above the box trees that cover much of the lowlands. It is made by covering the hump with a number of layers of blankets and felt pads and then forcing them up into a ridge by binding them round tightly with rope.

In Hadibo, where the visitors' house had collapsed in the rains of the previous season, the expedition rented an untenanted private house consisting of two small rooms forming two sides of a walled courtyard. Here we established our clinic which was daily crowded with patients of all ranks and both sexes, many of whom had come four or five days' journey over rugged country from the extreme ends of the island. The diseases our doctor had to deal with included (for the benefit of future visitors): malaria (which took a chronic form, probably more than 60 per cent. contracting it before the age of ten), pneumonia, chronic bronchitis, tuberculosis, scabies, osteomyelitis, anterior poliomyelitis, elephantiasis, sickling, leprosy, cancer and yaws, besides the usual run of conjunctivitis, skin complaints and internal troubles. The most popular form of treatment among the populace was the penicillin injection, which had somehow acquired a reputation as an aphrodisiac.

Although Hadibo is the seat of government of both the Sultan's territories in Mahra and Socotra, it is really no more than a village of small, one-storey, mud and coral houses, with a total population not exceeding four hundred. Most of the inhabitants are of foreign origin—Seiyids from the Ahl Hamad and Aidarus in the Hadhramaut, descendants of immigrants from the Persian Gulf, the Yemen and Saudi Arabia, who, having come to trade, settled down to breed another first generation of Socotrans who would grow up to speak a language and practise a way of life peculiar to the country and a form of Islam peculiar to the Muslim world. Generally these coastal Arabs have no political influence—the ruling class, with the Sultan at its head, being drawn from Mahri tribesmen—but constitute the Muqaddem (headman) and merchant class, acting as agents between the bedouin and visiting dhow captains. This means that they must travel round the country acquiring goods from the bedouin by purchase or barter, and selling these goods to dhow traders from India, Abadan, Muscat, Mukalla and Aden. The products of the island are exotic but unremunerative—*samn* or *ghi*, made by the bedouin, and reputed to be the best in this part of the world; a small quantity of dragon's blood

(the resin of the dragon's blood tree); aloes, lichen, ambergris, civet musk, dried shark, pottery, pearls, rugs, skins, tobacco and mother of pearl. These are exported in return for maize (the staple food of the islanders), rice, cloth and a few oddments such as crockery, fish-hooks and groceries. There is a two-way traffic in dates, and some visiting dhows take on salt from brine evaporated in pans at the hamlet of Neht on the south coast. The economy is thus a poor one, and it is difficult to see how it could be greatly improved, though yields in agriculture (at present practically restricted to Hadibo and certain more fertile wadis to the east), fisheries and livestock, could be increased. In a rainless year a considerable proportion of the population is at or near famine level.

There are about two thousand Africans living in the principal settlements of Qalansiya, Qadhub, Hadibo and Suk on the north coast. Most of them are descendants of slaves imported from East Africa during the nineteenth century, and some old men remember having been freed in their own lifetime. A few of the younger ones are offspring of West African troops stationed on Socotra during the war. They generally constitute the artisan class, and a number of them are dhow sailors and pearl fishers. Some of them have obtained positions of importance and responsibility—the Wazir, for example, was born of an African mother.

The expedition stayed two weeks in Hadibo, during which time Shinnie found traces of former occupation at Suk, once the capital of the island. Here he began excavations which he continued from time to time throughout the expedition. On August 16 a second base camp was established in the Haggier Mountains, at a place called Kishin, a resting place for camels on a major route across the island. This tented camp was at 2000 feet above sea level, where the climate was most salubrious after the dry heat of the plains. The mountains rise to nearly 5000 feet and form the central massif of the island. They are extraordinarily worn and pinnacled, usually cloud-covered and damp (Scotch mists are common) and with all exposed rock covered in a grey scab of lichen. There are at least three levels of small, grassy, water-parting plateaus from which, on the south side, descend deep and precipitous gorges leading to steep, red sandstone wadis, the sides of which are capped with rotting limestone often 300 feet thick. These wadis eventually debouch on the southern coastal plain. The upper reaches of the Haggier Mountains are often densely vegetated, grotesque *adenium* trees giving way to the characteristic dragon's blood trees, like umbrellas blown inside out, and to frankincense and myrrh trees and aromatic shrubs which make parts of the mountains smell like a perfumery. The topmost rocks have probably never been submerged and form one of the oldest land surfaces in the world. These have constituted an ark of refuge for many species of plants and animals unique to the island, roughly two-thirds of which are indigenous. Fauna and flora have extraordinarily far-flung relationships —Polynesian, South American, Asian, African and Mascarene. Gwynne was constantly busy with his biological collections.

Our medical work formed a convenient way of breaking down the shyness and suspicion of the bedouin who inhabited the mountains. We paid many visits to their villages and cave homes. They are not purely troglodytic people, since they only inhabit their highland caves during the summer when the lowland pasturage for their cattle dries up and forces them to find fresh grazing grounds in the higher and better watered parts of the mountains. Otherwise they inhabit small villages usually of not more than a score of houses, which are often to be found in the most secluded valleys. Their houses are small, circular or rectangular, built of dry stone and roofed to a depth of two or three feet with small stones and earth, supported by

beams of acacia or dragon's blood branches which radiate from central pillars of unmortared stone. Their caves are often situated at the tops of steep slopes and precipices, and are usually very bare. Normally there is an inner recess for the women of the family. The caves are also shared by the goats and by a large number of fleas. The bedouin are pastoralists, with an intelligence and language limited to the requirements of their simple life. Their economy is founded on the *ghi* which they make from the milk of their tiny cattle and which they exchange in Hadibo for dates, maize and other necessaries. As recently as the eighteenth century they practised a form of Christianity, and though now formally Muslim it would seem that they are more pagan than anything, practising witchcraft and litholatory. Their social system is still based on a patriarchal organization and has as yet been little investigated. A number of them speak a broken Arabic but no European has yet learnt their own peculiar language (called by other Arabs "the twittering of birds") which is certainly closely related to Mahri spoken on the mainland opposite and is believed by some to be a daughter tongue of ancient Sabaean and Minaean. Until this language has been learnt it is difficult to see how much more can be discovered about their particular mode of thought, folk tradition, religious belief and social organization. They have undoubtedly been isolated from the outside world for many thousands of years, since they have no knowledge of navigation: their only contact with the modern world has been through the few visiting Europeans, a contact that has (perhaps fortunately) done little to disturb their customary way of life except to introduce them to the monetary system, in which they are keenly interested! Their culture has remained at a Stone Age level—they have no knowledge of metal making, or of the potter's wheel.

Apart from treks in the mountains the expedition made two longer treks of a week or more duration—one to the extreme east of the island, along the coast to Ras Momi, the other to the southern coastal plain. Trekking on the island is hard, for the ground is exceedingly rough and rips shoes to pieces in no time. Baggage can be carried by donkeys, but in many places the terrain is impossible for animals —certain parts of the south-east and south-west coast, for example, have to be circumnavigated by boat, and during our trek to Ras Momi the donkeys had to be abandoned on two occasions when they were unable to follow the party's route—once when an ascent was made from the coast at Ras Momi on to the high limestone plateau that covers most of the eastern portion of the island, and again when it was decided to follow the seaward side of a high hill called the Batajeber along a track that necessitated rock-climbing in parts. Water is also an important consideration. In the mountains there are many perennial streams and on the north coast the wells of the main settlements are always full, but in the summer months many of the streams dry up and numerous small coastal hamlets are abandoned by their inhabitants until the rains of the north-east monsoon in November–February refill their wells and turn the dry wadis into torrents. The limestone plateaus are particularly barren and waterless, especially in the south-west. During the trek to the southern plain the party had to turn back at Haif Wells (where the water was salt) because no more water seemed to be available further along.

On September 29 the mountain camp at Kishin was finally abandoned and the following day most of the expedition stores were moved to the airstrip by camel. By now the strong winds of the south-west monsoon had dropped, after having blown continually twenty-two hours a day during our stay at an average of about 40 m.p.h., often gusting up to 60–70 m.p.h. The sea was thus calm enough for us to transport ourselves and the remainder of our equipment to the airstrip by *huri*

(dug-out canoe). On October 3 we left in two transport aircraft for Aden, accompanied by a shipwrecked Arab sailor who had been cast up on the island a year previously. Lack of time had prevented any work being done in the western half of the island.

Scientific work

Archaeology.—Shinnie made an archaeological survey of the eastern half of the island. At Suk, with the assistance of a team of local men and boys, he excavated what proved to be the remains of the Portuguese occupation of 1507–11—the Mahri fort which the Portuguese had occupied under Admirals Tristan da Cunha and Alfonso Albuquerque, and the mosque nearby which they had converted into the Church of Our Lady of the Victory. On the top of a hill called Hasun outside Hadibo he also found the remains of a second fort, with thick outer walls, which is believed to have been built by Mahri Arabs during their conquest of the island after the Portuguese had left. At Eriosh, at the western end of the northern coastal plain, he found limestone slabs containing various inscriptions—pin-drawings of men and camels, representations of mens' and camels' feet, and marks that looked like the letters of some alphabet written in long snaky lines. These latter, according to Bent who saw them in 1897, were Ethiopic letters, almost exactly similar to those he saw at the church in the ancient capital of Abyssinia, Axum. They probably date from the sixth century when the Abyssinians overran Southern Arabia for a short time.

Little else was found on the coast that gave any indication of important ancient settlement. There was no trace of a Roman trading post and the former capital of Suk was found to be no earlier than medieval. Our time and resources were, however, limited, and it is possible that in our rapid survey of the north coast between Eriosh and Ras Momi we overlooked less obvious evidence of ancient occupation. The 'Periplus of the Erythraean Sea' clearly states that Socotra was a busy trading post in about the first century A.D., and it is interesting to note that in the account of Diodorus the Sicilian (first century B.C.), who sometimes admittedly confuses the actual Socotra with the legendary Panchaia, there is a description of a large and very elaborate temple (a result, he says, of prosperity founded on a share of the ancient incense trade), the situation of which seems to coincide with the Mahri fort on top of Hasun. It is interesting to speculate whether the remains of such a temple may lie under the rubble of Hasun.

In the mountains we found clear traces of a more advanced and energetic culture than exists at the present day. Near Kishin and Ferageh were found sections of a stone-paved road, now overgrown and forgotten. Our camp at Kishin was erected on an elaborate and ancient man-made terrace, one of many in the mountains, which may have been used in the cultivation of incense in the days when this was a valuable commodity. At Ferageh, in the heart of the mountains, we discovered a large triangular blockhouse beside an artificially deepened moat. The walls were built of massive boulders, and there were the remains of turrets at each corner. Formerly ascribed to the Portuguese, the building was probably another medieval Mahri fort. Other remains of stone buildings in the mountains were said by local bedouin to be of Christian origin. Some of them were of quite elaborate construction, with dressed-stone walls of double thickness, paved courtyards, and semicircles of worn stones like seats in a small amphitheatre. One building even had a fireplace and chimney of dimensions most untypical of the bedouin. It is possible that one or two of these buildings may be early Christian chapels, particularly as in some rooms there were altar-like stones erected. There is clear evidence of an important past among the previous inhabitants of the interior of the island, but

further investigation is needed. We were unable to examine the west end of the island where discoveries made during the last war (large ruined "temples," cave-drawings, etc.) suggest that this part may have been an important area of settlement in ancient times.

Anthropological.—In addition to their medical work, the doctors collected a hundred bedouin blood samples. Blood grouping of these indicates an aboriginal population of a more than average pure Arab type. In view of the round-headedness of the majority of the bedouin and the physical features of some of them (small, sturdy build; dark skins; curly hair and almost beardless faces) it seems likely that the aboriginals of Socotra are the remnants of an Hamitic population once widespread in Southern Arabia and later driven out by a long-headed Semitic race from the north. They may thus, perhaps, be called one of the few "genuine" Arab communities, though differing in physical type, language and culture from the majority of the inhabitants of Arabia. They appear to be closely related to the Mahri and to the Qara and Shahara peoples of Dhufar, likewise submerged tribes who have sought refuge from invaders in natural mountainous asylums.

Apart from blood samples and racial-type photographs the expedition also brought back human bones discovered in walled-up caves. These, it is believed, are the remains of the Christian ancestors of the present bedouin, buried in Christian cave-tombs. With the bones were found pieces of embroidered clothing, a carved ivory kohl-container, and a wooden jar with its stopper. The bones have been brought back for measurement and will ultimately undergo a newly-devised blood grouping test, which may throw further light on the racial origins and affinities of these little known and isolated people.

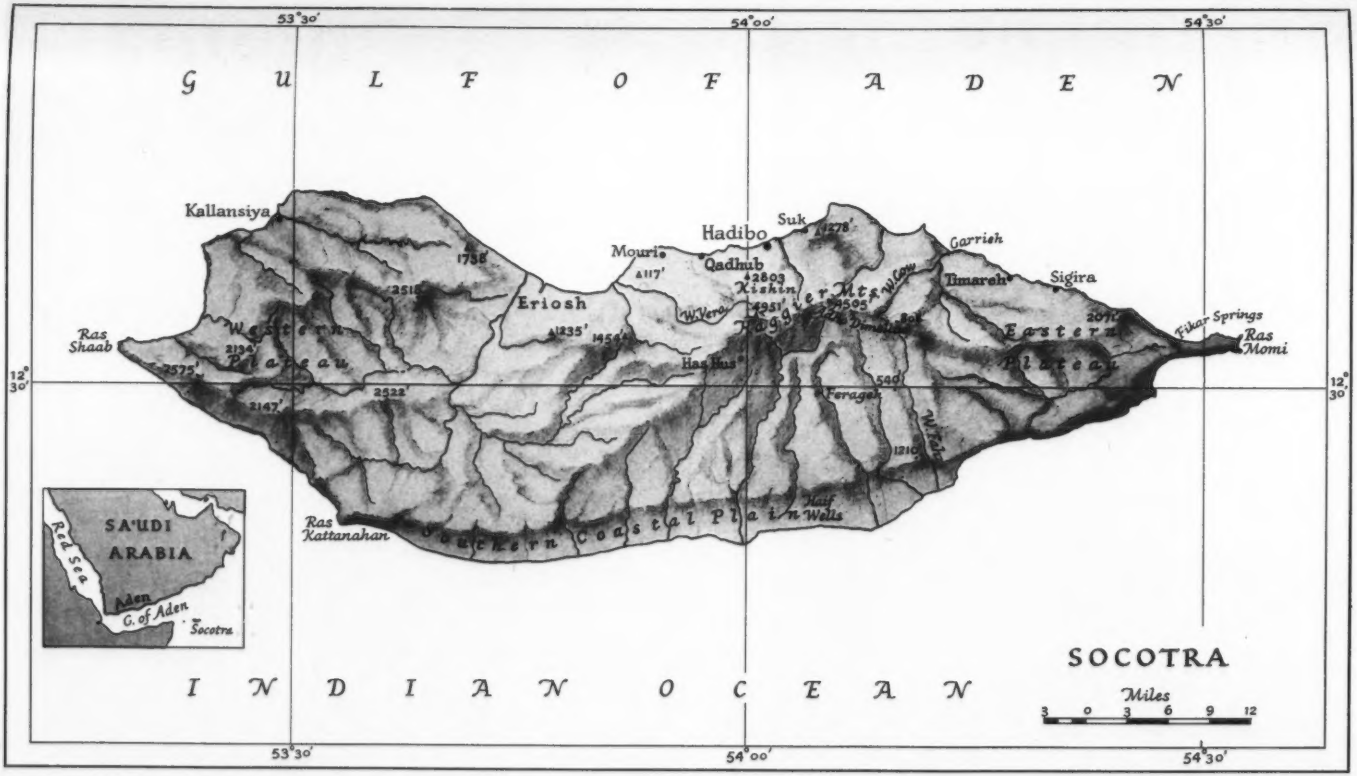
Biological.—A general vegetation survey was made by Gwynne of certain areas on the north and south slopes of the Haggier Mountains, and on the surrounding plains. A large collection of plants was made, mainly from the mountains. Soil samples were collected for antibiotic research. A collection of specimens of reptilia was made, both alive and preserved, and a collection of Arthropoda, especially Orthoptera. The specimens are now in the British Museum (Natural History) and it is not yet possible to say how far the collection has added to knowledge of Socotran fauna and flora.

It is a great pity that we did not think to blood-group Socotran cows during our stay on the island. They are unique to the island and resemble most closely Jersey Island cattle, though it is impossible that they came from there. They have the distinguishing characteristics of being without humps (unlike modern cattle in neighbouring parts of the world) and of being of dwarf size. They were probably brought over from Southern Arabia by the original settlers on Socotra, and there is some evidence (*e.g. graffiti* found in the Hadhramaut by Freya Stark of small unhumped cows) that suggests that they, like their owners, may have been indigenous to that country, later replaced by an invading species.

Miscellaneous.—Tape recordings were made of the Socotran language. These included short stories with Arabic translations and lists of Socotran words with parallel Arabic translations. Tape recordings were also made of Socotran music.

Products of Socotran crafts were collected, including pottery, blankets and silverware. Observations were made of Socotran folk medicine, and specimens of local drugs and medicinal charms were brought back.

The film of the expedition was shown in two parts by B.B.C. television on 1 and 15 January 1958: part one showing the life on the coast, part two the lives of the bedouin in the mountains.


GULF OF ADEN
INDIAN OCEAN
53°30'
54°00'
54°30'
12°30'
Kallansiya
Hadibo
Suk
1278'
Mouri
4117'
Qadhub
Garrish
Timareh
Sigira
Eriosh
1758'
2515'
1235'
1954'
Ras Shaab
Western Plateau
2134'
2575'
2147'
2522'
Has Hus
Ferage
540'
1210'
Wadi
Ras Momi
Fikar Springs
Eastern Plateau
Ras Kattanahan
Southern Coastal Plain
Wells
SA'UDI ARABIA
Red Sea
Aden
G. of Aden
Socotra
SOCOTRA
Miles
3 0 3 6 9 12

Little Sultan's Palace, Hadibo plain; Haggier foothills behind

Bedouin village, southern coastal plain, deserted during dry season

Bedouin cave home, Kishin

Socotran camel country; slope of 'aqaba *at Ras Hebak*

Adenium obesum *tree, Socotra*

Fortress wall and moat; Ferageh

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It is hoped to publish the results of the Oxford University Expedition in the following scientific journals: *Antiquity* (archaeological results); *Journal of the Royal Anthropological Society* (anthropological observations and blood-group results); *Nature* (general biological results); *Journal of Ecology* (results of ecological vegetation survey); *Ibis* (notes on Socotran birds).

DISCUSSION

Afternoon Meeting, 3 June, 1957

Before the paper the CHAIRMAN (The Rt. Hon. LORD RENNELL) said: I have been asked to take the chair to introduce Mr. Botting who is going to speak about Socotra. Socotra is an island off the Horn of Africa which has been visited at rare intervals in recent times by administrative officers from Aden. It was, however, at one time a trading post well known to the Portuguese, and of course to Arab traders from the Persian Gulf.

The Oxford Expedition to Socotra was on the island for a comparatively short period; it enjoyed the support of the Royal Geographical Society; it received the assistance of the Government of Aden and the generous help of the R.A.F., without which the expedition probably could not have achieved what it did in the time available. There are several authorities on that part of the world in the audience. I will, after the lecture, ask them to be good enough to add any comment they wish about the expedition and the results which Mr. Botting and his companions achieved in the field of geography, anthropology and other sciences.

Mr. Botting then read his paper

The CHAIRMAN: Fortunately, we have with us Sir Bernard Reilly, formerly

Governor of Aden, and also Mr. Harold Ingrams, both of whom are very well acquainted with the area of which we have heard.

Sir BERNARD REILLY: I have several times been on Socotra but never penetrated beyond the capital, Hadibo, which appears on many maps as "Tamarida." I do not know whether Mr. Botting can explain why that name is used, but I have been told it is a Portuguese name; anyway, it is not known to the present inhabitants; they know the modern capital only as Hadibo. I have been up into the foothills of the magnificent mountain range, but have never had time during my short visits to see more than that particular corner of the island.

The pictures have brought back to my mind very pleasant memories of my experiences on that island; I always wished I could visit it more frequently. Moreover, I had never the opportunity of going at the time of year in which the Expedition was there, for I used to go only in winter. Those were the days when I served in Aden. There was no aircraft landing ground on Socotra and I used to rely on the kindness of H.M. Navy to get me there in one of the naval sloops, and the Royal Navy used also to like only to go to Socotra in winter when the sea was sufficiently smooth to land on the coast. As you can imagine, that coast is unapproachable for a large part of the year because it catches the full force of the south-west monsoon.

I wonder if you will bear with me if I add a word or two in regard to the cattle on Socotra. I noticed none in the pictures today but my recollection of the cattle there is that they were a small and rather nice breed but all had straight backs; they had no humps, whereas the cattle in those parts of the world are nearly always humpbacked. At any rate I never saw any that were not humped, apart from those on Socotra.

Mr. Ingrams then spoke

Dr. A. E. MOURANT: I have listened with great interest to the lecture, and I must say that I feel it a great privilege to have been allowed to take a small part in helping the expedition. The results of the tests are quite clear-cut in one sense. They were technically quite satisfactory, but we cannot compare this population, as our lecturer has said, with any other that we know. At the moment we are engaged on an extensive survey of the population of Arabia; we are testing something like 1500 of the employees of an oil company, but so far they have only sent us the specimens under numbers. Until they give us a breakdown into tribes we cannot compare our results with those from Socotra. The overall results are not very similar: generally speaking, the Socotrans appear more Asiatic, as you will have judged from the pictures. I, personally, seeing that Socotra is a little nearer Africa than Asia, was expecting an African blood picture. One can on blood grouping results make a broad distinction between an African and an Asiatic type of population, and these results definitely showed that the Socotrans were more Asiatic than African. Putting it very roughly, one might be able to synthesize such a mixture as one finds in the bedouin on Socotra by combining something like 80 to 85 per cent. of Asiatic and 15 to 20 per cent. of African ancestors. In the same sense one finds something like 20 per cent. of African components in the ordinary population of Egypt and of Arabia, and even 10 per cent. in the Arabs of Iraq, for instance, largely brought in, as in most of the Moslem countries, as slaves. I hope that when we have more complete results from Arabia, partly from the work we are now doing and partly perhaps from future expeditions, we may be able to say something more definite in regard to the origin of the Socotrans from the blood group point of view.

With regard to bones, some of those present may know that the Natural History Museum has set up a blood grouping laboratory, with the express object of determining the blood groups of ancient bones. It is a somewhat laborious technique and one not yet fully worked out. Also one cannot hope to get anything like such complete results working on old bones as one can get when working on fresh blood. We may hope, I think, that in the course of the next few years we may have some results

from work on the bones brought back from Socotra which may tell us whether or not their blood groups resemble those of the present-day Socotrans, quite apart from the measurements which will also be made upon them.

When I heard about the small cattle on Socotra I was most disappointed that we did not get blood from them also, because just about the time that the expedition was in Socotra some work was started on the blood of cattle which promises interesting results from the anthropological point of view; that is to say, there is some hope of tracing the movement of human tribes accompanied by their cattle as they came from Asia or Africa or both into Europe. I think the cattle on Socotra resemble some of the smaller breeds of cattle of Western Europe and they may provide an interesting clue.

Dr. O. G. S. CRAWFORD: I have never been on Socotra, but in doing some work on the Sudan I had to go over documents which constantly referred in rather a vague way to Socotra and to the fact that there were supposed—they did not go beyond that—to be in existence there some Christians. Among the Missionary records there are a number of somewhat vague references to Christianity in Socotra. In 1704 a certain Father Joseph who had just returned from Abyssinia was given a grant in order to send a mission to the Christians who were supposed to survive on the island. Actually the mission never took place, but there is this continual reference which must, I think, have some ground. More than that I do not think anyone knows; how Christianity got to Socotra is, I think, completely unknown.

I have recently heard that there is a project to appoint an archaeology officer to Aden who would thus also cover Socotra. That is a project which archaeologists have been in favour of for many years. It is hoped that something will eventually result because, as we have seen, there is a good deal to be done on Socotra.

The CHAIRMAN: Time is getting on and I can only express the hope that the archaeological department will activate itself very soon, because there appears to be a great field, and one of probably great importance, in Socotra and that neighbourhood.

One subject near to my heart is that of trying to ascertain whether or not there are traces of either Greek or Roman settlement and occupation. It is evident that Mr. Botting and his friends in the brief two months they were on the island have covered quite a large enough field to stimulate interest in a number of other expeditions to Socotra. You will wish me not only to thank Mr. Botting for his paper but also to congratulate him and his friends upon some really magnificent photographs.

FURTHER EXPERIMENTS USING RADIOACTIVE METHODS TO DETECT THE MOVEMENT OF SHINGLE OVER THE SEA BED AND ALONGSHORE

C. KIDSON, A. P. CARR AND D. B. SMITH

THE USE OF radioactive substances for marking beach material in order to trace its movements, is increasing rapidly. Experimental work, already carried out and planned, is perfecting a series of techniques which may soon be regarded as standard practice. The method has been applied to silt,[1, 2, 3] sand, [4, 5] and shingle.[6, 7]

The great interest in the marking of beach material with radioactive tracers stems from the lack of information of how this material moves over the sea bed. As Dr. Martin A. Mason, the Chief of the Engineering and Research Branch of the Beach Erosion Board in the United States, has said[8]: "Estimation of the material volume derived from or lost to the adjacent sea bottom is unsatisfactory at present . . . there is little, if any, evidence of a conclusive nature with respect to this phenomenon in Nature." Radioactive marking promises to supply the conclusive evidence which is lacking, since it allows the actual material of the beach to be used and makes it possible to trace the movements of the material under the influence of waves and currents. It is possible to locate it on the sea bed without dredging and it can be detected even when buried on the beach to a depth of 8–9 inches.

The experiments described in the present paper were carried out off Orfordness in Suffolk during the period from January to March 1957. Earlier work at Scolt Head Island, Norfolk, on the movement of shingle over the sea bed [6, 7] demonstrated the practicability of the method as applied to shingle. The trials off Orfordness were designed to develop the techniques employed at Scolt Head Island and to study specific coastal problems at Orfordness.

Choice of tracer.—As in the experiments at Scolt Head the isotope barium 140–lanthanum 140 was chosen for the Orfordness trials because it fulfils the principal requirements for the purpose; it emits high-energy gamma rays enabling it to be detected at distances of about 10 inches in water and it has a half-life eminently suitable for experimental work of this nature. This half-life (12 days) is long enough to enable tracing to be carried out over a reasonable period—the Orfordness experiments lasted for some 7 weeks—but short enough to eliminate any health hazards if the pebble were picked up by a member of the public. It is also necessary to have a short-lived material if repeat experiments are to be carried out in the same area.

Barium 140 decays by the emission of beta-particles and low-energy gamma rays to form the isotope lanthanum 140, which then itself decays with the emission of beta-particles and high-energy gamma rays with a half-life of 40 hours, to form the stable isotope cerium 140. Barium 140 is produced by irradiating uranium in a nuclear reactor. One of the many fission products of the uranium nucleus is barium, and this may be separated chemically from all the other elements, and obtained in a solution as "carrier-free" barium 140. This means that virtually all the atoms of barium present in the solution are radioactive, and the total mass of barium present is very small.

Immediately after separation, the lanthanum 140 starts to be formed, and increases with a half-life of about 40 hours until it reaches equilibrium with the decaying barium 140 and the two then decay together with a half-life of 12 days. The lanthanum builds up to within 20 per cent. of its equilibrium value within 5 days, and it is suitable for use as a tracer after this period. If all the labelling and the transporting of the

pebbles can be carried out within a day of the production of the barium, then the hazard of handling the material with the highly energetic gamma rays from the lanthanum is very greatly reduced. This is one of the very few cases where such a saving in handling is possible and is an important point in favour of using barium 140 as the tracer.

In practice the transporting of the radioactive pebbles from Harwell to Orfordness was completed within 12 hours of the preparation of the barium 140 and few precautions in transit were necessary. Handling of the pebbles during the injection at the experimental sites was carried out rapidly and resultant risks thereby considerably reduced.

Marking the pebbles.—Experience in the Scolt Head experiments,[7] where the radioactive tracer was inserted into a hole drilled in the pebble, led to the search for a simpler, easier and less expensive technique of marking. It was discovered that a tracer could be made to adhere to the surface of the flint shingle of Orfordness and could be fixed by baking. For the Orfordness experiment flint pebbles were selected which had a surface layer of ferric oxide, since it was found that adsorption of the radioactive isotope was greatest with these pebbles. Later work has demonstrated that adsorption can be achieved without this ferric oxide layer. A possible disadvantage of surface marking of the pebbles is that the radioactivity might be removed by abrasion of the surface under normal coastal conditions. Shaking experiments in the laboratory showed that the sample flint pebbles of Orfordness suffered negligible loss of weight and their high resistance to surface wear makes them particularly suitable for surface labelling. Of the materials tested under laboratory conditions the flint pebbles were, in fact, the only ones suitable for surface labelling. The activity uptake of the individual pebbles varied over the range from 8 to 35 microcuries of barium 140, with an average of 16 microcuries. The total activity of the 2600 pebbles used in the experiment was about 40 millicuries of barium 140 (in equilibrium with 40 millicuries of lanthanum 140) at the start of the experiment on January 23. The number of pebbles was restricted by the bulk of material which has to be handled during the labelling and baking.

Instrumentation and tracing.—As in the Scolt experiment, tracing under water was carried out by searching the sea bed with Geiger counters mounted on a heavy metal sledge (plate 1). The Geiger detector consisted of three G60H tubes, spring mounted, inside a strong waterproof brass tube, which also enclosed a simple trigger valve circuit. A 4-core cable and steel lifting cable were enclosed in 60 feet of hose pipe and coupled via a junction box to a 1292A field ratemeter. The detector was spring mounted on a heavy iron sledge so that there was about 2 inches clearance between the casing and the sea bed when the instrument was towed behind a boat. Using some 50 feet of chain, the sledge could be towed at approximately 2 knots behind the boat and still maintain contact with the sea bed. Difficulty was experienced with the sledge becoming inverted, and it has now been made symmetrical so that it can be towed either way up. It is hoped that the new design will prevent the sledge from digging in when travelling over an uneven sea bottom. Due to the attenuation (adsorption) of the gamma radiation from the tracer in water, the pebbles can only be detected about 10 inches away. Hence large detectors such as the 60-centimetre-long Geiger counters sweep a channel between 3–4 feet wide when towed on the sledge, and give a greater probability of locating isolated pebbles than would be obtained if a more sensitive but smaller detector was used.

An important departure from the Scolt Head technique was the use of a transversely sprung scintillation counter mounted on a Dexion sledge for the detection of pebbles cast upon the open beach by wave action (plate 2). The scintillation counter was also used at low tide to detect pebbles on the exposed shingle banks offshore. It was found that pebbles on the beach surface could be detected at an average lateral distance of 15 feet and buried pebbles could be located at depths of the order of 6–9 inches. Since beach searching involves towing the Dexion sledge for considerable

Table I

RADIOACTIVE SHINGLE EXPERIMENTS, ORFORDNESS, 23 JANUARY–7 MARCH 1957. SECOND EXPERIMENT (INSHORE INJECTION OF 23 JANUARY)

Orford beach searches	*Date: 1957*	*No. of positive contacts*	*Distance travelled in feet from point of injection*			*Offshore searches*	*Date: 1957*	*No. of positive contacts*	*Distance travelled in feet from point of injection*			*Direction of wave approach*	*Remarks*
			Max. north	*Min. north*	*Max. south*				*Max. north*	*Min. north*	*Max. south*		
1	24.1	70	785	37	—	—	—	—	—	—	—	—	
2	25.1	102	1070	69	—	2a	25.1	4	832	439	—	South (slight)	
3	26.1	84	1037	65	—	—	—	—	—	—	—	South (slight)	
4	28.1	81	1931	106	—	—	—	—	—	—	—	South	
4•	29.1	—	1935	106	—	—	—	—	—	—	—	South (slight)	
4•	1.2	—	1815	—	—	—	—	—	—	—	—	Normal	Second limit check
5	2.2	88	2095	373	—	5a	1.2	10	1820	320	—	South (slight)	
5•	5.2	—	1815	—	10	—	—	—	—	—	—	South changing to normal	
6	6.2	56	2104	143	—	—	—	—	—	—	—	South to normal	
7	8.2	45	3060	14	—	7a	9.2	8	2600	555	—	Variable	From this date
						7b	10.2	0	—	—	—	South	on max. north
8	12.2	57	3356	501	—	—	—	—	—	—	—	Normal	movement is
8•	13.2	—	3131	—	—	—	—	—	—	—	—	South	deceptive
9	15.2	71	3017	77	—	9a	19.2	22	6774	1011	—	North	since markers
10	20.2	96	3004	—	25	—	—	—	—	—	—	South changing to north	tossed to top of beach at springs have been removed from circulation
11	23.2	100	2854	67	3166	11a	26.2	15	—	—	3341	Variable but dominantly north	
						11b	26.2	8	—	—	—		
12	28.2	46	2399	—	1354	—	—	—	—	—	—	Normal changing to north	
13	5.3	22	2171	498	—	13a	7.3	1	—	—	2874	Normal changing to north	
						13b	9.3	0	—	—	—		

• Indicates limit check only.
a Indicates a full offshore search using Geiger counters, and scintillation counter on offshore shingle banks drying at low tide.
b Includes searches of Shingle Street beaches employing scintillation counter.

distances, a high sensitivity instrument of small size and weight is most suitable. For this purpose a scintillation counter and large plastic phosphor were used. The phosphor and photomultiplier (E.M.I. Type 6097) were mounted in a strong waterproof shell and 10 feet of cable running inside a hose pipe connected the counter to a type 1320 ratemeter.

Control and plotting.—The two points of injection of the radioactive shingle were fixed with reference to shore traverse stations established earlier and marked by beacons 12 feet in height. In each case a line of ranging poles was laid out from a traverse station and the point of injection was in prolongation of this line. The precise point was established by sextant angles to other traverse stations and the initial fix was checked by independent observations from the shore. In this way the position could be accurately fixed and re-established without the need to put down marker buoys, which were found at Scolt Head to be a considerable inconvenience during sweeping. In sweeping subsequently with the Geiger counters underwater the technique adopted was as follows. As soon as a contact with a pebble was recorded on the ratemeter, the boat's engine was stopped and the boat drifted by hauling on the towing warp of the sledge until it was vertically above the Geiger counters. The position of the Geiger counters was then established by sextant angles from the boat to three of the traverse stations on shore. In sweeping the beach with the scintillation counter a similar technique of fixing with a sextant was adopted but subsequently abandoned in favour of distance and offset owing to the difficulty of plotting sextant angles with a station pointer when the position to be recorded was, inevitably, close to the traverse stations.

Table I (p. 212) gives a summary of the results of all searches both onshore and offshore.

Weather records.—Throughout the period of the experiments, 23 January to 7 March 1957, records were kept of wind and wave conditions. The strength and direction of the wind was recorded by hand anemometer and prismatic compass solely to discover if the detailed records from the Meteorological Office Stations at Gorleston and Felixstowe were applicable to conditions in the experimental area. Close agreement with the Felixstowe data was established. A summary of selected wind strengths and directions based on Felixstowe data is given below.

Table II

Days on which wind blew between north and east	*Maximum speed in knots*	*Days on which wind blew between north and west*	*Maximum speed in knots*
February 19	6	February 10	18
„ 20	9	„ 12	11
„ 22	10	„ 14	20
„ 26	10	„ 15	9
„ 27	1	„ 16	7
March 4	6	„ 18	6
„ 5	12	„ 20	8
		„ 21	1
		„ 26	8

Wind blew from between south and east on 17 days with a maximum recorded speed of 22 knots and from between south and west on 33 days with a maximum speed of 26 knots.

The site of the experiments.—Orfordness in Suffolk was selected as the site of the experiments largely because the Coastal Research Unit of the Nature Conservancy had already carried out a considerable programme of work in the area. Consequently

all the survey work, both topographic and hydrographic, for the control of the experiments had been completed earlier. The use of radioactive methods for the study of the movement of beach material, while of interest and value as a separate study, fitted into the research programme already under way. An additional factor influencing the choice of locality was the isolated nature of the beach and the difficulty of public access. This formed an essential part of the safety precautions laid down by the Health Physics Division of the Atomic Energy Research Establishment, Harwell.

Orfordness is a large shingle spit, the largest of the East Coast shingle spreads, which runs for a distance of some 11 miles southwards from Aldeburgh, diverting the River Alde from its natural outlet near the town. Beyond its southern tip, North Weir Point, the spit is continued still further south by shingle banks locally called knolls, across the mouth of the River Alde, here known as the Ore, to Shingle Street. This, as its name suggests, is a vast accumulation of shingle derived from the spit.[9, 10] The shingle continues south as far as Bawdsey and then again to Felixstowe. The experiments described in this paper were carried out in the area of North Weir Point, extending approximately $1\frac{1}{2}$ miles northwards and 1 mile southwards. A characteristic cross profile of the shingle spit in this area is given in Figure 1. This clearly shows the steep nature of the beach on both the river and sea sides and shows also the generally flat nature of the hard sandy sea bed.

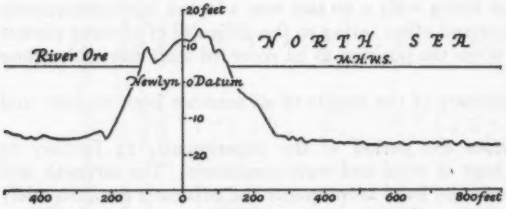
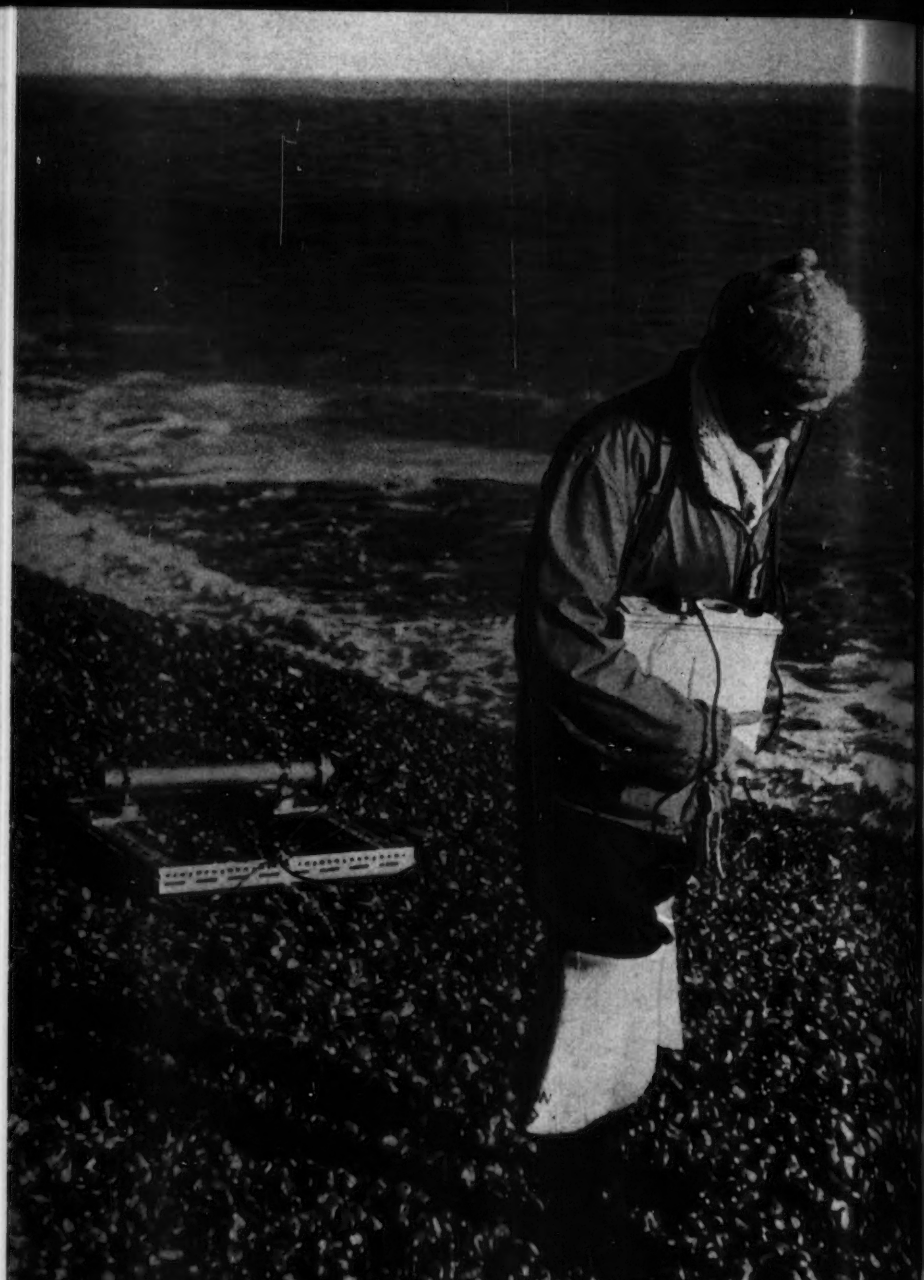


Figure 1

Objects of the experiments.—A prime purpose of the experiments at Orfordness was to follow up the 1956 work off Scolt Head Island,[6, 7] to learn something more of the possibility that beaches are supplied, in part, with material from the offshore zone. It had been established in the 1956 experiments that shingle did move slowly and mainly landward, under moderate wind and wave conditions, in water up to 25 feet in depth. Secondly, it was hoped to determine under field conditions precisely what happens to material which is carried by littoral drift to the distal point of a spit. This problem is posed at Orfordness in an extreme form since between North Weir Point, the end of the spit, and Shingle Street, on the opposite bank, tidal flow on both the flood and the ebb, into and out of the River Ore, can be as much as 7 to 8 knots. Finally, it was expected that further experience in the use of the radioactive marking technique would lead to improvements in both methods and instruments.

Movement in the offshore zone.—The experiments at Scolt Head showed that pebbles deposited some 500 yards offshore in water varying with the tide between 12 and 25 feet in depth, moved generally shorewards. The experiment could not be continued for a sufficient length of time to determine if, and in what manner, the pebbles arrived on the beach. The Orfordness trials were planned, in fact, to "bracket" the Scolt experiment. On the one hand some pebbles were to be deposited much closer inshore in shallower water, while others were to be deposited further offshore and in deeper water. In this way it was hoped to add to the lessons of the earlier experiments. About 600 pebbles marked with radioactive tracers were deposited nearly 700 yards offshore in water which varied in depth between 19 and 28 feet, according to the state of the tide. The position of injection is marked in Figure 2 by a small triangle and the number 2. It lies nearly $1\frac{1}{2}$ miles north from North Weir Point, and almost $1\frac{1}{4}$ miles from the site of the second inshore experiment described below. The pebbles used in both experiments were a random sample of flint shingle taken from the beach and thus they conformed exactly in size

1. Geiger counters and field ratemeter with towing sledge



2. Towing scintillation counter equipment over Orfordness beach

range, specific gravity and other physical characteristics with the other material in the areas of injection. The only selection to take place was that to ensure pebbles with a surface layer of ferric oxide as described earlier.

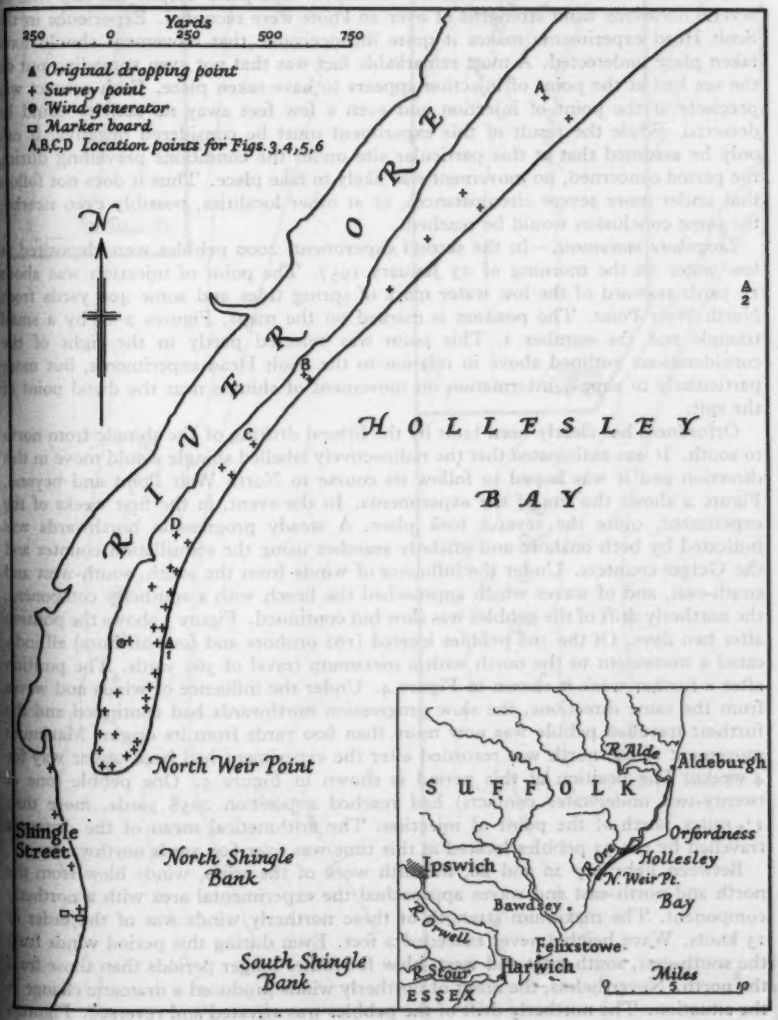


Figure 2

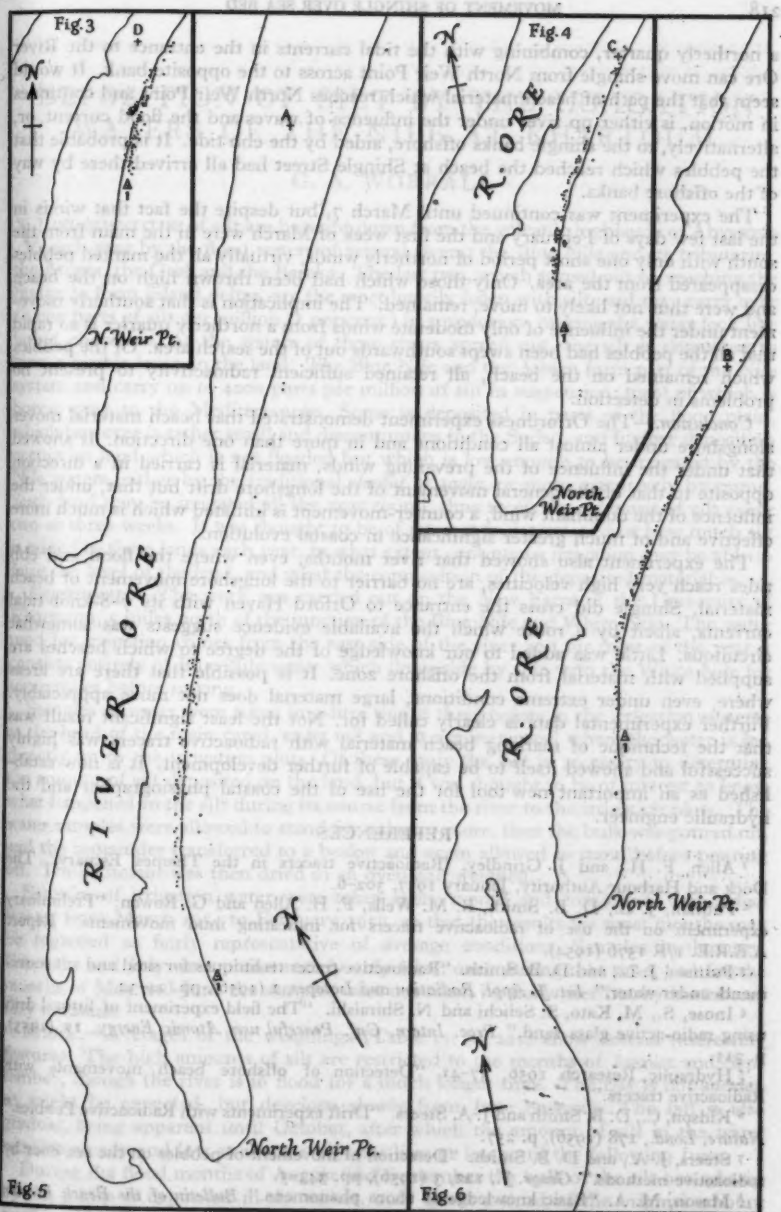
Between January 25 and March 7 searches of the sea bed using the Geiger counters, mounted on the sledge and towed behind a motor launch, were carried out whenever conditions at sea permitted. On each of the eleven occasions the method adopted was to steam to the point of injection, locate it if possible and then cover the surrounding area of sea in a cross hatch pattern of sweeps. Contact was established by means of

the Geiger counters on eight occasions. Each time the contact occurred at the point of injection and at no time was there any contact away from this point despite the fact that on each sweep up to five hours were spent in sweeping the surrounding areas. This means that no movement whatsoever took place despite the fact that on several occasions wind strengths of over 20 knots were recorded. Experience in the Scolt Head experiments makes it quite inconceivable that movement should have taken place undetected. A most remarkable fact was that not even spreading out on the sea bed at the point of injection appears to have taken place. Each contact was precisely at the point of injection and even a few feet away no activity could be detected. While the result of this experiment must be considered negative, it can only be assumed that at this particular site under the conditions prevailing during the period concerned, no movement was likely to take place. Thus it does not follow that under more severe circumstances, or at other localities, possibly even nearby, the same conclusion would be reached.

Longshore movement.—In the second experiment, 2000 pebbles were deposited at low water on the morning of 23 January 1957. The point of injection was about 12 yards seaward of the low water mark of spring tides and some 400 yards from North Weir Point. The position is marked on the maps, Figures 2–6, by a small triangle and the number 1. This point was selected partly in the light of the considerations outlined above in relation to the Scolt Head experiments, but more particularly to supply information on movement of shingle near the distal point of the spit.

Orfordness has clearly been built by the littoral drifting of the shingle from north to south. It was anticipated that the radioactively labelled shingle would move in this direction and it was hoped to follow its course to North Weir Point and beyond. Figure 2 shows the site of the experiments. In the event, in the first weeks of the experiment, quite the reverse took place. A steady progression northwards was indicated by both onshore and offshore searches using the scintillation counter and the Geiger counters. Under the influence of winds from the south, south-west and south-east, and of waves which approached the beach with a southerly component, the northerly drift of the pebbles was slow but continued. Figure 3 shows the position after two days. Of the 106 pebbles located (102 onshore and four offshore) all indicated a movement to the north with a maximum travel of 360 yards. The position after a further week is shown in Figure 4. Under the influence of winds and waves from the same directions, the slow progression northwards had continued and the furthest travelled pebble was now more than 600 yards from its origin. Maximum movement to the north was recorded after the experiment had been under way for 4 weeks. The position at this period is shown in Figure 5. One pebble (one of twenty-two underwater contacts) had reached a position 2258 yards, more than $1\frac{1}{4}$ miles, north of the point of injection. The arithmetical mean of the distances travelled by the 93 pebbles located at this time was over 600 yards northwards.

Between February 20 and 26, the fifth week of the trials, winds blew from the north and north-east and waves approached the experimental area with a northerly component. The maximum strength of these northerly winds was of the order of 15 knots. Wave heights never exceeded 2 feet. Even during this period winds from the south-east, south-west and west, blew for rather longer periods than those from the north. Nevertheless, the onset of northerly winds produced a dramatic change in the situation. The northerly drift of the pebbles was arrested and reversed. Figure 6 summarizes the position revealed by sweeps on the sea bed, the offshore shingle banks and the beaches on February 23 and 26. The calm weather of this period made it possible to relate and compare sweeps carried out several days apart. Clearly an appreciable southerly movement had taken place. Marked pebbles were detected south of the point of injection, at North Weir Point, on the beach fronting the River Ore, on the shingle banks at the entrance to Orford Haven and on the beach at Shingle Street. From this evidence it would appear that waves approaching from



Figures 3, 4, 5 and 6

a northerly quarter, combining with the tidal currents in the entrance to the River Ore can move shingle from North Weir Point across to the opposite bank. It would seem that the path of beach material which reaches North Weir Point and continues in motion, is either up river under the influence of waves and the flood current, or, alternatively, to the shingle banks offshore, aided by the ebb tide. It is probable that the pebbles which reached the beach at Shingle Street had all arrived there by way of the offshore banks.

The experiment was continued until March 7, but despite the fact that winds in the last few days of February and the first week of March were in the main from the south with only one short period of northerly winds, virtually all the marked pebbles disappeared from the area. Only those which had been thrown high on the beach and were thus not likely to move, remained. The implication is that southerly movement under the influence of only moderate winds from a northerly quarter is so rapid that all the pebbles had been swept southwards out of the search area. Of the pebbles which remained on the beach, all retained sufficient radioactivity to present no problems in detection.

Conclusion.—The Orfordness experiment demonstrated that beach material moves alongshore under almost all conditions and in more than one direction. It showed that under the influence of the prevailing winds, material is carried in a direction opposite to that of the general movement of the longshore drift but that, under the influence of the dominant wind, a counter-movement is initiated which is much more effective and of much greater significance in coastal evolution.

The experiment also showed that river mouths, even where the flood and ebb tides reach very high velocities, are no barrier to the longshore movement of beach material. Shingle did cross the entrance to Orford Haven with its 7–8-knot tidal currents, albeit by a route which the available evidence suggests was somewhat circuitous. Little was added to our knowledge of the degree to which beaches are supplied with material from the offshore zone. It is possible that there are areas where, even under extreme conditions, large material does not move appreciably. Further experimental data is clearly called for. Not the least significant result was that the technique of marking beach material with radioactive tracers was highly successful and showed itself to be capable of further development. It is now established as an important new tool for the use of the coastal physiographer and the hydraulic engineer.

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DEPOSITION OF SILT BY THE IRRIGATION WATERS OF THE NILE AT KHARTOUM

G. A. WORRALL

VAST QUANTITIES of silt are brought down from the volcanic highlands of Abyssinia each year by the flood waters of several rivers: the Blue Nile and its tributaries, the Atbara, the Gash and the Baraka. The last two, which spread out on reaching the Sudan to form inland deltas, are the most heavily laden with silt, and may carry over 10,000 parts of silt per million (1 per cent.) in suspension, making the water look like liquid chocolate. As the waters of these rivers spread out, the silt is deposited to form a visible layer on the land. The Blue Nile and the Atbara form part of the Nile system and carry up to 4000 parts per million of silt in suspension, most of which is borne away to the Mediterranean. Some is deposited in parts of the flood plain, which however is rather small and discontinuous in the Sudan, and further deposition occurs on land which is not flooded but which is low enough to be irrigated by the Nile waters, either by the traditional *shaduf* or *saqia*, or more extensively by pump. Such land may be irrigated all the year round, thus receiving a deposit of silt every two or three weeks. It was thought to be of interest to determine just how much silt is added to these lands each year, to what extent continuous irrigation may be able to raise the level of the land, and what the composition of the deposited material is.

Experiments.—The work was carried out on the New Farm of the University of Khartoum, 5 miles north of the junction of the Blue Nile and White Nile. The water used for irrigation comes from the east side of the river and for most of the year it consists entirely of Blue Nile water which flows side by side with the White Nile for some miles before mixing.

Samples of water were taken in 4-litre tins at three points in the irrigation system: at the head of the main canal, at its tail and at a minor canal where the water is led directly on to the irrigation plots. Of these, only the last is necessary to determine the amount of silt deposited on the land, but it was thought to be of interest to know what happened to the silt during its course from the river to the irrigation plots. The water samples were allowed to stand for a day or more, then the bulk was poured off, and the remainder transferred to a beaker and again allowed to stand before pouring off. The sediment was then dried in an oven and weighed.

Samples of irrigation water were taken every month and continued, with a few lapses, from March 1954 to February 1957, so that the results for most months may be regarded as fairly representative of average conditions. Samples in January, February and July were unfortunately only taken once during that time, and for the months of May and June the samples were not taken by the writer but by his laboratory assistant.

Results.—Averages of the weighings (Table on p. 221) show several interesting features. The high amounts of silt are restricted to the months of August and September, though the river is in flood for a much longer time. The rise is not sudden as might be expected, but develops slowly from June onwards. The fall is also gradual, being apparent until October, after which the amount of silt in the water remains steady and low at about 0·1 g. per litre or less until the following June.

During the flood months of August and September the bulk of the silt brought up by the pump is deposited in the canals, only about a third of the original amount reaching the plots. This silting up of the canals is a regular occurrence, and the silt has to be periodically dug out. During the remainder of the year, deposition is slight in the main canal, while in the minor channels there is frequently more silt than was contained in the water at the head of the canal. The reason for this is that the soil is

often disturbed in the minor channels and the relatively silt-free water is able to take additional material in suspension. This erosion is however quite small and is not likely to have any noticeable effect on the canal system.

The average amounts of silt in the water of the minor canals have been expressed as the weight in kilogrammes deposited per acre per month at the rate of one watering of 400 tons per acre every fourteen days (Table on p. 221). The total deposition over a year, assuming regular waterings for the whole period, as is the case with lucerne, amounts to 2500 kilogrammes or about $2\frac{1}{2}$ tons per acre. This weight may be expressed as a depth of soil. Taking the apparent density of the soil as 1·5, the weight of 1 centimetre/acre is approximately 60 tons. Therefore, with regular watering the land on the University farm would be raised by 1 centimetre in twenty-four years. But the land lies fallow for about half the time thus raising this figure to about forty-eight years. Also annual crops receive much fewer waterings per year. Against this however it should be noted that these crops are watered during flood time so that the large bulk of the year's silt is brought on to the land. Thus the number of years required to deposit 1 centimetre of silt is likely to be about fifty, or 2 centimetres per century. This is a much slower rate than might be expected on seeing the heavily laden red-brown water of the river at flood time, but most of the silt never reaches the irrigation plots.

It might be expected from this that the coarse part of the suspension would be left in the canals and only the fine mud carried on to the plots. This is only partially true as will be seen from the following mechanical analyses of scrapings from the canal head, the canal tail and two plots carrying perennial crops, the soil of which has not been ploughed for at least three years (expressed in percentages):

	Stones and gravel	*Coarse sand*	*Fine sand*	*Silt*	*Clay*
	>2 *mm.*	2–0·2	0·2–0·02	0·02–0·002	<0·002
Canal head	—	0·8	89·5	4·2	5·5
Canal tail	—	2·3	27·4	38·7	31·6
Plot 1 (banana)	0·7	13·7	36·1	12·3	33·3
Plot 2 (citrus)	0·8	7·7	42·9	12·5	36·2

At the canal head the velocity of the water is at its maximum and greater than that of the river, and so the suspension consists mostly of sand. At the canal tail and on the plots more fine material is deposited but it should be noted that much sand is brought to these points as well. The plot analyses have two interesting features. The first is that the silt content is much decreased, and the second that the fine sand and coarse sand have increased, as compared with the deposit in the canal tail. The first can be attributed to the weathering of the silt particles on drying and wetting frequently on the surface of the ground. The second, which at first sight appears to be an error, is explained by the formation of secondary minerals, in this case grey calcareous nodules of fine sand size and above. These concretions are a regular feature of the semi-arid clay soils of this district as shown by Worrall (1957), but their presence on the surface of plots protected from wind erosion is good evidence that they are forming at the present day at a rapid rate.

Mechanical analyses of the material suspended in the Nile are given by Ball (1939) and Simaika (1940) for Wadi Halfa, Aswan and Cairo as follows (in percentages):

	Stones and gravel	*Coarse sand*	*Fine sand*	*Silt*	*Clay*
	>2 *mm.*	2–0·2	0·2–0·02	0·02–0·002	<0·002
Wadi Halfa (Aug.) ..	—	—	24	42	34
Aswan (Aug.)	—	—	15	40	45
Cairo (Aug.–Nov.) ..	—	0·2	18·5	26·3	55·0

The gradual increase of clay content is explained by Ball as due to the slow fall of the coarser material to form the bottom load of the river. The figures show, however, that even at Cairo the grading of the suspended matter is not very good. The speed of flow of the water evidently remains sufficiently great to keep suspended particle sizes up to about 0·2 mm. diameter all the way to the sea. Conversely, particle sizes above this are not carried by the river even as far upstream as Khartoum as is shown by the analyses previously given.

The effect of the suspended matter on the fertility of the land is generally believed to be beneficial. In the lower reaches of the Nile in the Sudan there are elongated depressions which are irrigated by the Nile flood each year. If it should happen that they become flooded with rainwater before the Nile reaches them, it is drained off to allow the Nile water to enter. On the other hand, in the Tokar delta in the extreme east of the Sudan where the land is flooded by the heavily laden waters of the Baraka river, the farmers lift off the current season's accretion of silt and plant their seed in the previous season's layer. The explanation for this can be found in the effects of the weather on the silt, the raw minerals having been broken down to produce available plant nutrients. The silt of the Nile, however, has suffered a good deal of weathering by the time it reaches the Northern Sudan and the sand fraction is largely quartz. The work of Shukri (1950) and of the writer (1957) showed that the heavy minerals of the sand fraction contain a considerable amount of the unstable minerals augite and hornblende which could produce some bases on weathering, but there is not much orthoclase felspar to provide the potassium or apatite the phosphate, and it is likely that the benefit of the Nile water lies more in the dissolved solids (some 100 to 200 parts per million) and in the finer fractions of the suspension. Chemical analyses of the total suspended matter made at Cairo and quoted by Ball indicate that its potential nutritional value is quite high (potash about 1 per cent., phosphate and nitrogen each about 0·2 per cent.). But against this it should be noted, as already shown, that the amount of silt added each year is very small, *i.e.* in the order of $\frac{1}{5}$ millimetre, so that it would need to be rich in available nutrients to have much immediate fertilizing value.

Monthly averages of silt carried and deposited by irrigation water at Khartoum

	Weight of silt carried by irrigation water (g. per litre)			*Rate of deposition (kgm. per acre)*
Month	*Canal head*	*Canal tail*	*Minor canal*	
January ..	0·027	0·022	0·030	24
February ..	0·080	0·068	0·155	124
March ..	0·085	0·062	0·085	68
April ..	0·087	0·066	0·071	57
May	0·038	0·027	0·043	34
June	0·212	0·162	0·222	178
July	0·450	0·407	0·615	492
August ..	3·375	1·650	1·200	960
September ..	1·195	0·807	0·372	298
October ..	0·294	0·202	0·174	139
November ..	0·062	0·091	0·107	86
December ..	0·041	0·083	0·101	81
				2541 kgm./acre/year

Summary

The silt from the irrigation water on the farm of the University of Khartoum is deposited mostly in the months of August and September. There is a gradual rise from June onwards and a gradual fall until November. Most of the silt is dropped in

the canals before the water reaches the irrigation plots. In the winter months the amounts of suspended matter is usually less than 0·1 g. per litre, and irrigation water at this time may cause slight erosion of the minor canals.

The average amount of silt deposited annually on irrigated land is estimated at about $1^{1}/_{4}$ ton per acre, or, expressed as a depth of silt, about 2 centimetres per century.

The silt deposited on the irrigation plots, though heavier than that brought from the river, is shown by mechanical analyses to be poorly graded. This is also true of Nile silt in Egypt, and it appears that the river does little sorting and carries a similar range of sizes up to about 0·2 millimetres diameter from Khartoum to Cairo.

The mineral composition of the silt is referred to, and its value as a fertilizer discussed.

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THE RIM OF THE PACIFIC

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THE PACIFIC "RIM" is a girdle surrounding the deep ocean basin of the Pacific; if we neglect the curvature of the earth, it may be likened to the raised rim of a tray. Over vast areas of the "basin" the floor is comparatively smooth—but not quite smooth, as there is an unexplained small relief of "valleys, ridges, and troughs" (Menard, 1956) that has recently been discovered and is ubiquitous except where obliterated by accumulation of lava and of the sediment forming "archipelagic aprons" (Menard). Of a much larger order, however, are scattered mounds of volcanic origin which are of huge size, though dwarfed by the vast dimensions of the surrounding basin. Some of the volcanoes that originated on the sea floor have been built up to form existing islands, but others fail to reach within several hundred fathoms of the surface of the sea, either having become the foundations of atolls or remaining submerged as seamounts. Away from these (and not far from them) the water is very deep, though the maximum depths, up to 6 miles, are confined to the narrow but elongated ocean deeps.

In contrast with some monotony on the basin floor, relief is varied in many parts of the rim, consisting of mountain chains, though in other places are curving festoons of islands, not all of them high. The rim does not coincide in position with the geographical boundary of the ocean; rather is its position definable in geophysical and geological terms, so that the rim concept is as much geological as geographical. In the western Pacific it is far out in the Pacific Ocean, though necessarily in such a place it is discontinuous, consisting of islands. Behind the rim, to the west, is a shelf-like belt of marginal seas that are in general shallower than the basin.

In terms of the classic sial and sima, the floor of the basin consists of sima which is almost bare,* its only cover, as indicated by geophysical investigation supported by seismic evidence, being a thin layer which must consist for the most part of abyssal sediment; and the Mohorovičić discontinuity is at a depth rarely greater than 6 miles below sea level. Over the floors of the marginal seas outside the rim, however, there is some sial, though it is a layer very much thinner than that which forms the continents (Gutenberg, 1951). A remark of Officer *et al.* (1957) made with regard to the contrasting floors of the Atlantic Ocean and Caribbean Sea is applicable to those of the Pacific basin and the western seas. Unless they were different "it would be difficult to understand how an island arc and deep-sea trench might develop between them."

A pertinent question concerning the floors of the western Pacific seas is whether they have originated from primitive ocean floor (*Urozean*) or from continental land. It has often been assumed that this extensive region is of foundered continental origin. Diversified major topography of some parts of the ocean floors may seem to

* In this usage, sial includes the whole of the lighter, outer terrestrial layer down to the Mohorovičić discontinuity, sima being the denser material of the earth's "mantle" below it; though Gutenberg (1955, p. 21) prefers to call this "ultrasima," transferring sima to the "intermediate" layer below the upper, or "granitic," layer of the sial of the continents—apparently more basic, perhaps basaltic, in composition, but still above the "Moho." For sial, in the inclusive sense of all layers above the Moho, "crust" is sometimes substituted, but this is ambiguous, as it has other meanings. Gutenberg (1955, p. 20), who recommends that "crust" be not used unless the author supplies a definition, equates it himself with "lithosphere" as distinguished from "asthenosphere," so that he "includes the Mohorovičić discontinuity in the crust." The present writer's definition is "the deformable skin of the earth" (Cotton, 1956).

indicate that they have been land, though the relief may on the other hand be partly of submarine tectonic origin. The conclusion reached by Officer (1955) as a result of geophysical studies is that the floor of the Tasman Sea is of the oceanic, not continental, type. The ocean floor south-east of New Zealand has as much relief as that to the north-west under the Tasman Sea; this sector of the rim has, however, been formerly much broader. Extensive land to the east has been postulated by Kingma (1957) to account for facies of Cretaceous sedimentation, and according to Wellman (1955) there was high land west of the South Island of New Zealand until mid-Tertiary times, at which date most of the area that is now land in New Zealand was still submerged.*

For criticism of the theory of foundering of continental land to make marginal seas we may turn to a study made by Officer *et al.* (1957) of a similar region which, however, is marginal to the Atlantic basin. This is the part of the Caribbean Sea that is separated from the Atlantic by the island arc of the Lesser Antilles, a feature strikingly similar to some parts of the Pacific rim. Geophysical survey has shown that the floor of the basin is neither typical ocean floor nor continental land but is of an intermediate character, and the investigators favour the hypothesis that it is in course of transformation from one of these types to the other. They think it improbable that it is continental sial that has been already partly transformed by some process of loading so that it is now in isostatic equilibrium though submerged to a depth of 3 miles. A mechanism for transformation of true ocean-floor material (like that of the Pacific basin) that has been suggested (Ewing, Officer *et al.*, 1957, p. 910) involves differentiation and separation of the lighter compounds deep in the mantle. This could lead to the upward migration of a differentiate of andesitic composition.

To return to comparison of the rim itself with the oceanic basin: there are various contrasting features. One difference which, though perhaps secondary, has been the most often cited is the difference between volcanic activity within the basin and that on the rim; in the basin it is basaltic and on the rim andesitic. The distinction between basaltic and andesitic lavas is chemically small, and might seem not worth stressing; but the real point of distinction is the fact that the types of activity associated with them are very different (Cotton, 1952, p. 152). Outpourings of lavas of generally basaltic composition in large quantities characterize the basin: one may take as an example the floods of quietly flowing lava that well out from, and have built up the huge domical volcanic mountains of the Samoan and Hawaiian islands, and also the islands now carved by erosion into fantastic forms (but initially similar to these) in the Society, Marquesas, and other groups of dissected volcanoes. Associated with such outflow of basalt there is but little explosive activity and what there is is due to special local causes. In strong contrast with this (Hawaiian) volcanic type is the largely explosive volcanism of the rim, where, though lava-flows are poured out also, the rising lava, being more siliceous, and correspondingly more viscid when it approaches the surface, commonly explodes as its contained gases are liberated and thus provides much fragmentary debris. This is built into steep-sided ash cones, the proportion of such debris to flowing lava being generally high.

The characteristics of the volcanic activity of basaltic and andesitic regions being so different, it is not surprising that a boundary line between them should have been mapped. This line surrounds the Pacific basin, separating the basin from the rim. On the eastern side the boundary between lava-differentiated regions is indefinite in some parts, notably near Easter Island, though on other grounds the rim may be said to end not far from the shorelines of North and South America (or at the deep sub-oceanic trench bordering the latter). On the western side, however, the line is far out in the Pacific Ocean, zigzagging among South Pacific island groups, the Fiji group being west of it, for example. This is the line defined long ago in that region by P. Marshall and called by him the "andesitic" or andesite line; by that name (or

* All are not agreed as to whether a narrow strip along the site of the Alpine divide in the South Island escaped submergence (Wilson, 1956).

the "Marshall line") the boundary between basin and rim is now generally known. It has, however, been alternatively called the "sial line" (by H. T. Stearns) apparently for two reasons: (1) it separates the (sial-less) basin from the western seas which have some sial on their floors; and (2) there is presumably either an admixture of sial in the andesitic lavas, giving them a more siliceous composition, or else they are derived by some petrological process from the sial itself, whereas the basalts of the basin must be derived entirely from (ultra) sima of the earth's mantle.

It cannot be assumed that all parts of the zigzagging course of the andesite line are known with certainty. To take an example, the line is generally drawn with a salient passing eastward around the Mernoo Bank and Chatham Islands, which might take in also a former eastward land extension of New Zealand already referred to. Yet an alternative tentative position of the line would be under the gravels of the Canterbury Plains, in the South Island, which seem to fill a syncline that possibly continues the Tonga-Kermadec deep south-westward. In favour of this line of demarcation it might be urged that it would assign the basalt volcanoes of Banks Peninsula, which are of the Hawaiian type, to the Pacific basin.

Though defined on the basis of underlying magmas and their volcanic products, the line is of even greater significance in that it separates the basin region, the largest homogeneous unit of strong individuality on the earth's surface, a region which is so peacefully at rest that no tectonic earthquakes originate within its boundaries, from the adjacent mobile belts of the Pacific rim. In the rim, not only is much explosive volcanic activity concentrated in parts of a narrow belt, but seismic activity also is concentrated in parts of the same belt to the extent that 80 per cent. of shallow and nearly all other earthquakes originate in it (Gutenberg, 1951).* Absence of seismicity in the basin and its prevalence in a rim are peculiarities of the Pacific Ocean; within the Atlantic and Indian Ocean basins, there are numerous seismic foci and Gutenberg (1951) remarks on the absence around those oceans of any "discontinuity" comparable to that between the Pacific floor and rim. The short Antillean sector of the Atlantic border (*supra*) is quite exceptional in its "Pacific" characteristics.

Neither volcanic nor seismic activity is evenly distributed throughout the Pacific rim, and furthermore the areas characterized by volcanic and by seismic activity are not everywhere the same. Something that is more fundamental even than the concentration of volcanic centres and of earthquake foci in particular areas is the evidence found in the same and in adjacent parts of the rim of recent differential movement; this consists of young fault-block mountains, activity of major strike-slip faulting and transcurrent drift, and the occurrence of upheavals and submergences on a large scale—as indicated by raised coral reefs and other shoreline features, and by deeply drowned coastal outlines.

Earthquakes, and perhaps to some extent volcanic activity, are secondary effects of those earth movements, including faulting, that affect the deeper parts of the crust and extend also to the surface. To the same cause must be ascribed the prevailing strong relief, the actually mountainous character, of many parts of the circum-Pacific girdle. This is not confined as strictly as seismic activity to such parts as are now mobile but is also found in parts that have been mobile comparatively recently. There are large sections of the girdle, however, that are either still mobile or have been mobile so recently that strong relief survives in them—not yet destroyed by erosion—and so the description "rim" is justified.

Associated with all the rim characteristics already mentioned is the fact that the rocks of which the emergent and mountainous parts of the circum-Pacific girdle are composed include thick, folded sedimentary formations—in addition to the abundant volcanic materials, some of which are comparatively ancient, though others are still accumulating. Thus the whole girdle marks the site of a Pacific-encircling infilled geosyncline. The sedimentary fill consists in part of redeposited debris of ancient

* *Cf.* Gutenberg, B., and C. F. Richter. 'Seismicity of the Earth,' Princeton, 1954: Figure 3, "World map of shallow earthquakes."

volcanic activity, but some of it also appears to have been derived by erosion from continental lands.

There is a certain danger of confusing the ancient folding of the geosynclinal fill in the rim regions with the origin of the present-day mountainous relief, and with faulting that currently affects the same regions, causing earthquakes. They are, however, distinct and separate phenomena, though they may be causally related. Whether there are here two or three distinct sets of phenomena, the folded structure of the rocks must be set aside as something that originated in a remote past, whereas the rim features that are of geographical interest are comparatively new. As compared with rock-folding, mountain growth took place but yesterday, and in some places apparently it continues today—*i.e.* where its continuance is manifested by seismic activity.

It would be futile to attempt to describe every part of the rim. Attention may be concentrated mainly on the New Zealand sector of it, this being one of the best known, and on what is known (though as yet very imperfectly) of its origin and history. It is interesting to find that this sector is by no means unique. Though it cannot be claimed as a representative sample of the whole rim, it is rather closely analogous with two other widely separated sectors, Japan and California. In California, especially, much information that is useful for comparison has become available in recent years. The resemblance thus revealed between two sectors of the rim, at opposite ends of a Pacific diameter nearly 7000 miles long, is remarkable, despite some differences that may or may not be of great significance.

The closest analogy is to be found in the great transcurrent faults of California and New Zealand or, perhaps better, the zones of lateral displacement containing such faults. The zones extend longitudinally through the two sectors with displacement of some hundreds of miles, and both are roughly parallel to the adjacent boundary of the oceanic basin. These are the San Andreas and associated faults in California and the Alpine Fault and transcurrent-fault zone of New Zealand (Wellman, 1955b). Though San Andreas fault movement has caused many earthquakes, by no means all those in California are due to actual slip on that line. In New Zealand likewise some major earthquakes have originated outside the transcurrent-fault zone. Yet the chief cause of earth movement that produces displacement along established lines of faulting, in both California and New Zealand (and in New Zealand causes fault breaks apparently to develop along some new lines), is quite probably lateral drift along the major dislocations or transcurrent-fault zones. These can scarcely be other than the surface traces of geosutures that extend far down into a subcrustal layer; it seems thus justifiable to call the faults in these zones "tear faults," redefining "tear fault" (which has been differently used) to mean "a fault produced in superficial rocks by tearing apart due to the differential lateral drift of underlying structures" (Cotton, 1956). Such movement, when it takes place now, may be merely a revival of adjustment that was common and of more general occurrence when the outer layers of the earth were comparatively new.

Recognition of the reality of lateral subcrustal movement (as evidenced apparently by the activity of great transcurrent-fault zones) necessitates acceptance of a concept that the crustal belts bordering such great faults and fault zones are drifting also; for these must ride on the backs of moving subcrustal sectors. In this a possible mechanism can be found for the crumpling, or "transcurrent buckling," of a thick layer; this buckling will be manifested by a breaking of the upper crust (if it is somewhat rigid) into faulted blocks, perhaps large in some districts and small in others.

New Zealand examples which it is natural to cite of breaking up into large blocks that may be due to this cause (though it is impossible to pronounce definitely on this point), are the ranges and basins of Central Otago (Cotton, 1955, pp. 139–83) and those of northern Nelson (Cotton, 1955, pp. 114–38). The Kaikoura ranges of Marlborough (Cotton, 1955, pp. 38–66), with their extension as ranges and basins in

North Canterbury, may be of the same nature, though it is possible that a different mechanism is involved there, seeing that transcurrent faults of the "zone" itself pass between the ranges.

As an example of a break-up of the upper crust into small blocks we have the assemblage of minor tectonic relief features which make up the lower ranges of the southern part of the North Island, notably in and around the city of Wellington (Cotton, 1957). So also, upheavals of parts of the New Zealand coast, the promontories bounding Hawke Bay, for instance, and the very deep submergence of other parts, such as the Marlborough Sounds (fringing the north end of the South Island), may be attributed (at least tentatively) to broad buckling due to the same cause.

Turning now to California, probable results of buckling due to drift along the San Andreas zone are seen in a disintegration of belts of its border terrain into the jumbles of large faulted blocks which form the Coast Ranges and Transverse Ranges. To select one small area as an example of the development and piling up of stress where drift is impeded, one may cite a local accumulation of north–south compressive stress which has been the cause of the White Wolf faulting, and of the associated earthquakes of 1952 (Benioff, 1955). Benioff attributes this to obstruction of continuous south-easterly drift by a salient due to a bend in the San Andreas Fault developed not long ago by the interference of a relatively minor transcurrent movement (that on the Garlock Fault) nearly at right angles to it.

The analogy of New Zealand with coastal California may be extended by comparing the basin of the Tasman Sea with the Great Valley of California. Though the latter is only 60 miles wide, it is a tectonic feature of the first order, 450 miles long and of great depth (infilled). The interior of western North America, including eastern California and Nevada, has then to be compared with eastern Australia. Here the analogy is reasonably close, though the American land is now much higher. Eastern Australia has bulged up unevenly, so as to develop considerable relief, contemporaneously with the development of New Zealand into a mountainous land. So also the Sierra Nevada range in California and the region east of it have been broadly upheaved with a certain amount of deformation while the Coast and Transverse ranges were growing with much stronger tectonic relief.

The two regions, separated by a diameter of the Pacific Ocean, were upheaved simultaneously and very recently, and both are still seismic. On the side facing the ocean each is now an assemblage of faulted blocks in rather jumbled patterns, and these parts are young lands. In answer to the oft-repeated question: is New Zealand very young? some geologists might answer that it is not, as it consists of as large a proportion of ancient rocks as most other countries. These rocks are formed for the most part, however, of sediments that have accumulated under the sea. More recently for many millions of years, and even in late Tertiary times until about a million years ago, most of the site of New Zealand remained submerged. Though it has been quite correctly described as consisting of an archipelago in late Tertiary and early Pleistocene times it is difficult to say with certainty of any part of central New Zealand that it was continuously land even at that late date. The pattern of islands changed from time to time, and eventually parts of the former archipelago were upheaved in a new pattern of mountainous tracts of country. This upheaval, which involved emergence of much of the area from the sea, was a geologically recent event, or rather series of events, for it did not take place at the same time throughout the area. Some quite considerable parts of New Zealand emerged and assumed mountainous stature within a fraction of a million years ago, though other parts had become land considerably earlier—let us say "several million" years ago (knowledge of the time that has since elapsed being still very imperfect).

California has a quite similar history: parts of it have emerged from the sea very recently. The two regions are indeed alike in that they incorporate in the structure of their land extensive areas and great thicknesses of very young marine stratified

formations (of Pleistocene age) such as are scarcely known in other parts of the world. In California these are in the Ventura and Los Angeles basins; in New Zealand they are in the western part of Wellington province (the upper stages of the Wanganui Series).

Even those parts of the two regions that were above the sea about a million years ago (or at any rate not more than two or three million years ago) were flat and at no great altitude. This is true indeed of the adjoining regions as well—that is to say of Australia and of the continental region east of coastal California. In New Zealand it is known that southern parts of the North Island that were not actually submerged had been reduced by prolonged erosion to a lowlying peneplain. At Wellington this is the "K Surface" (Cotton, 1957), which can be traced across the tops of small upfaulted blocks and can be seen also on the flanks of tilted blocks and of anticlinal or domical relief features of recent development. In the south-east part of the South Island also there are traces of such a surface, though the planation seems there to have been interrupted somewhat earlier by earth movements. The same surface of planation may have extended right across Fiordland and the site of the Southern Alps; it is well known that though ancient folded rocks are exposed in them these mountains are not very ancient, and in recent years Wellman and other geologists have described features indicating that the Alpine belt has been upbowed very rapidly even within the last 100,000 years or so.

In the analogous region of North America also evidence is accumulating that all the mountainous relief is very young—that upheaval to high altitudes took place only quite recently. A study has been made recently of a large number of widely scattered deposits in that region containing fossil plants (Axelrod, 1957); and the fossil floras reveal that there was uniformity of climatic conditions throughout a vast area at the time the beds containing the plant remains accumulated. Such a former uniform climate contrasts very strongly with the diversified climates of today in that region (as it now is) of mountains, plateaus, and enclosed basins. Many of the floras studied are no older than early Pliocene. They and the deposits containing them indicate that at least as late as that time California (including the Sierra Nevada) and the region farther east, which consists now of basins and ranges, were rather low-lying and had little relief, so that strongly contrasting climatic provinces had not yet been differentiated. Axelrod's estimate of the measure of the relief of that time is that on the site of the present-day Sierra Nevada there was only a very broad swell with altitude nowhere greater than 3000 feet, this surface being diversified only by shallow open valleys with a maximum depth of 1000 feet. The surface with low undulating relief extended eastward into the present-day Basin and Range province.

It is not to be assumed that this low-lying region was broken up immediately by earth movements but, perhaps long after the accumulation of the plant remains, California and Nevada bulged up into high relief and parts of them were broken into blocks. This event is dated by Axelrod "largely late Pliocene to middle Pleistocene." Thus the break-up and upheavals took place contemporaneously with those affecting Australia and New Zealand, where also (that is, in New Zealand just as in coastal California) they still continue. In this late episode of movement (partly at least in the Pleistocene) the crestline of the Sierra Nevada rose, according to Axelrod's estimate, 5000 or 6000 feet in the north and 9000 feet at the south end.

It thus appears that the New Zealand and Californian regions were already alike physically before they assumed their present-day configurations. They have both been affected, moreover, by modern mountain-making movements in very similar ways, or at any rate with similar results, so that one may suspect that the causes of mountain uplift were similar in both.

It has been customary since the earliest days of seismology to point out not only that, in a general way, the seismic belt and the volcanic belt (or "girdle of fire")

around the Pacific Ocean coincide with a rim of mountains, but also that these mountains are on the outcrops of a girdle of folded rock strata, the deformed sedimentary filling of a circum-Pacific geosyncline. No doubt the cause of circum-Pacific volcanism is related, either closely or perhaps only remotely, to the uprise of the mountains in the rim and to the accompanying earthquakes, and there must be also some fundamental or primary causal link with the folding of the rocks and even with the initiation of the geosyncline—but these were phenomena of quite ancient times. Volcanism, however, is not strictly a rim phenomenon; unlike the other rim characteristics it is equally common within the Pacific basin. Volcanic activity within the basin being unassociated with tectonic earthquakes, we must be warned not to infer too much from the occasional though far from general close association of volcanic with seismic activity in the more recently mobile parts of the rim.

The movements that have upheaved masses of the anciently-folded rocks in the rim to form mountains have been very recent as compared with the dates of folding of those rocks. Long ago when the rocks were deformed by folding, the faulting which accompanied the deformation must certainly have caused many violent earthquakes; and at one time and another every part of the folded zones must have been so shaken. Such earthquakes are, however, only inferred from the structure, which is everlasting though the folding that developed it is a thing of the far distant past. On the other hand, the movements that now produce earthquakes in parts of the folded belt are something new. Moreover, the seismicity of the present day is localized only in certain parts of the rim. For a striking example of such localization we do not have to look beyond New Zealand; only the central part of this sector of the rim and to a smaller extent the south-west corner of it are seismic.

Whether the faulting that now causes earthquakes is due to stresses of the same kind as those which folded the rocks is a matter for speculation, and it would be unsafe to assume that the stress pattern is the same now as in ancient times. An assumption that there is some, possibly remote, relation between the modern and ancient patterns can be based only on the fact that both present-day mobility and the older folding have affected parts of the same Pacific rim. Not only are the mountains younger than the rock folding, but in many places the seismicity may be related to movements which have just begun and are distinct even from those that made the existing mountains. This cannot be so everywhere, however. The mountain-making movements must themselves have caused earthquakes; some upheaval of existing mountains is still in progress, and modern earthquakes originate in some cases on the lines bounding upraised blocks, where faults are still active. Nevertheless this does not seem to be a quite general rule; faults that are now active appear in many cases to be new ones. Without making too fine distinctions of this kind it is safe to say, however, that current faulting and seismicity are closely related to the comparatively recent upheaval of mountains, though only very remotely to the more ancient movements that folded the rocks.

It was noted by Schwinner in 1941 (map reproduced by Umbgrove, 1947, Figure 133) that on the North American coast the stress that causes fundamental drift acts lengthwise along the rim (an inference from the San Andreas Fault drift), but in his opinion this sector is exceptional, maximum stress and movement being still across the rim in other parts—as it seems to have been when the old rocks were folded. (This is commonly thought of as either an overriding of the ocean floor by adjacent continental masses or a thrust of the ocean floors under the continents.) Gutenberg (1956, p. 419), on the other hand, sees evidence of a change in the direction of movements in the North American sector, transverse thrust being replaced by lengthwise, or "tangential," drift, a change he regards as not confined to California but affecting "many sectors" of the rim. Whether the theory is of such general application or not, drift parallel to the rim instead of a thrust across it is now dominant at least in California and New Zealand; and in this drift an explanation of the later mountain-building and of the seismicity may be found. The older geological idea (Suess;

Stille) of great wave-like folds in the crustal rocks spending themselves against and overriding the oceanic rigid mass (craton) may thus be set aside, at least as regards California and New Zealand, as a possible cause of mountain uplift and seismicity, helpful as it may be in explaining the folded structure of old rocks in these regions as well as elsewhere.

If we accept for these sectors the view of Gutenberg, which implies that the stress pattern has changed, bringing about a fundamental change in the tectonic mechanism, there is some danger of adopting that facile concept of geological history which divides up the course of events into distinct and discontinuous episodes. It is possible that the separation of two great phases of overfolding towards the Pacific and of major transcurrent drift parallel to the Pacific boundary may be more apparent than real. Perhaps the current phase of dominant transcurrent drift is not a new development but is merely a recurrence of movement that has been active intermittently since the earliest geological (and pre-geological) times. To explain this possibility it may be necessary to invoke the doctrine of a world-wide pattern of geosutures (as H. Cloos has called them), or regmatic joints (R. A. Sonder), on which the zones of greatest fault displacement may be aligned. At some geological periods overthrusting towards the ocean has perhaps obscured the regmatic (or ground-block) pattern and has thus merely overshadowed lateral drift.

In other regions, notably in the European Alps, the simpler theories formerly in vogue to explain complex structure have given way to recognition of greater complexity of tectonic processes—"a complicated interplay of several processes or . . . the superposition of later structures on those of greater age" (F. E. Zeuner). The concept of superposed tectonics may be of great significance as applied to California and New Zealand. In California it helps to explain the baffling results of attempts to restore the former trends of formations torn apart by lateral drift along the San Andreas Fault.

Any explanation of New Zealand geological history based on the oversimplified hypothesis that short periods of deformation have been separated by long resting periods is opposed by Wellman (1956) and Kingma (1957). Whatever may be the merits of a theory of unceasing movement at an "average rate . . . not very different from that of the present day" (Wellman, 1956, p. 31) as applied to the region as a whole, however, such a theory cannot be assumed to exclude the occurrence of anorogenic episodes in particular districts, evidence for which is afforded by planations. The analogy of California is helpful here. In California no evidence has been found of a Cretaceo-Tertiary cycle of sedimentation similar to the Notocenozoic as described in New Zealand, and in that span of time Coast Range geologists have described many orogenies; on the other hand it has not been suggested that any one of these has made a significant break that is recognizable throughout the region (Richter, in press).

The foregoing considerations lead to a conclusion that differences between geological patterns in California and New Zealand which have impressed some observers may turn out to be more apparent than real. The repetition, however, of similar tectonic patterns is very striking, and to find these at opposite ends of a Pacific diameter is the best indication of the continuity and unity of the Pacific rim.

Note: The foregoing note contains the substance of a lecture to the New Zealand Geographical Society at Wellington, 20 June 1957.

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GEOGRAPHY AND TECHNICAL EDUCATION

MEMORANDUM PREPARED by the Education Committee of the Royal Geographical Society, acting in the first instance through a Sub-Committee consisting of Mr. R. C. Honeybone, Mr. J. C. G. Sugden, Mr. W. Wallace (Geographical Association), and the Chairman, Dr. E. W. H. Briault. It is now published with the approval of the Council of the Royal Geographical Society and the Executive Committee of the Geographical Association.

The Royal Geographical Society and the Geographical Association, being aware of the increasing interest in and importance attached to liberal studies in technical courses, have felt it desirable to place on record what they regard as the important place which geography should have in such developments. In particular, it is understood that liberal studies are to have a place in courses leading to the Diploma in Technology and that they might be expected to account for between 15 and 20 per cent. of the total timetable. We believe that geography has a particular claim for consideration in such courses, both as an important cultural subject in its own right and as part of a general background study allied to a particular industry. The suggestions which follow are in line with the Ministry of Education Circular 323, on liberal studies in technical colleges.

It is the business of geography to describe and evaluate the interrelationship and interplay of human and natural factors in the varied environments of the world. These in themselves form the setting in which modern technological developments are taking place, a setting of which every educated person is cognizant to a greater or less degree.

One of the reasons why the study of geography has developed so much of recent years is the widespread recognition of its significance as an essential part of the education of the modern citizen. The facts of geography, whether they are studied on a local, national or international scale, are relevant and essential to a proper understanding of contemporary affairs. These facts may be concerned, for example, with the background of a particular industry, with the general economic and social life of Britain, with the political background of European, Commonwealth or world problems. It is clear that any understanding of economic and political planning is largely dependent on a proper study of the geographical background.

Another important feature of this "citizenship" aspect of geography is its value in encouraging a reasonable attitude towards change. In a rapidly changing world, it is important to help this attitude to develop, and in geography change is met with in immense variety, ranging from violent and catastrophic earth movements to slow and steady erosion and deposition; from the sudden development of an industry as a result of the discovery of a new source of raw material or new use for an existing material, to the gradual adjustment of an industry to new demands by the public; from the transformation of a dry area by the construction of great irrigation works, to the gradual development of agricultural production through the application of modern techniques and fertilizers.

Quite apart from the significance of the factual content of geography, the characteristic geographical method is such that it may well commend itself to the technologist who is seeking to expand his mental horizons. Basically, geography is a field science, and its fundamental knowledge is obtained by detailed observation and careful recording in town and country, at home and abroad. The physical and human elements of the landscape thus discovered have next to be analysed with a view to understanding how and why they have developed in the particular places where they have

been observed. This process will entail the study and use of large-scale maps. Some of the reasons that have to be examined in order to understand the many aspects of the landscape are those that will be familiar to the technologist. Facts of the physical landscape are frequently amenable to strictly scientific measurement and analysis, but when the more complex study of the human landscape is involved, the student of technology will be brought to realize the limitations of objective methods of assessment. The significance of man himself as one of the factors to be considered will be found to introduce a greater measure of subjective judgement. In such cases, personal judgement becomes increasingly important, and geography becomes akin to the humanities.

It is this kinship to the methods of both the sciences and the humanities that constitutes an important part of geography's value as a liberal element in a technological education. A further very important part is the stage of reasoning that follows the analysis of the facts observed and recorded in the field. A landscape does not consist of a series of unrelated details. Its parts show a subtle relationship one to another which constitutes the special character or "personality" of a region, and differentiates one region from the next. The attempt to weave the parts into a synthesis and thus provide a synoptic view of a region is characteristically geographical, and offers to the technologist an opportunity of thinking synthetically as well as analytically. Geography is in a unique sense a "bridge" subject between the sciences and the humanities.

Geography has an obvious and important advantage as a study for students of technology, since part of its realm of knowledge is directly relevant to their specialized studies. Thus, in the engineering or textile industry, students will see the relevance of being conversant with the distribution of the raw materials, the localization of factories and mills, and the potential markets. They will also appreciate the relevance of studying an industry in its regional setting so that they can see its significance in the general life of the community.

Modern developments in technology are increasingly international in character and take place through forms of economic organization which to an increasing degree transcend national boundaries. Geography, by its very nature, takes a world view, and the broad sweep of a geographical appraisal of modern economic developments thus provides a valuable and essential part of the outlook of the well-educated technologist. Some training in the geographer's characteristic approach should enable the student of a technical subject to appreciate both the local setting of the industry with which he is concerned, its raw materials and sources of power, and also the place and significance of these factors in a setting which is likely to be supra-national and may well be world wide.

The human aspects of technological developments may be no less significant than the economic. Here again, geographical studies may prove rewarding, since they will show economic factors in their human as well as their physical setting. The development of a particular resource in a new area, for example, brings human needs and problems in its train. The geographer will see such developments as a whole and the technologist who has some geographical training is more likely to range human values alongside scientific facts and economic needs in his appraisal of the whole situation. Such an approach, of course, is not confined to the geographer; but the particular intellectual discipline to which he has been subjected, of synthesis after analysis, makes him constantly aware of the significance of interrelationships of all kinds.

From the foregoing paragraphs, it will be clear that geography, presented in the modern manner, can play an important part in the liberal education of the technologist. It is necessary to stress, however, that geography today is very different in outlook and treatment from what it was in the past. Some practical examples may be given of the kind of geographical studies which, it is thought, might find a place in the liberal studies of the technical student.

(*a*) There is a place for the detailed study of a particular industrial concern and its relationship to geographical factors.

(*b*) The geographical study of the relevant industry or industries against the local, national and international backgrounds would have an obvious relationship to vocational studies. In some cases the local study of a topic may be followed by the study of the same topic in relation, first to another part of the country, and then to other parts of the world.

(*c*) A series of detailed "sample" studies of the geographical complex in varied areas can represent the chief ways of life in the world, and can illustrate some of the chief international economic and political problems. Basically, geography is the study of real people in real places. Such studies may be of sample areas or of regions; in either case the choice should be representative, some but not all being related to the technical students' other interests.

(*d*) A detailed "field" study in town or country, involving the extensive use of large-scale maps, can provide the opportunity to carry out some research at an appropriate level with all its resultant personal satisfaction. There is plenty of evidence to show that many men and women have developed a lifelong interest based on an appreciation of the scientific and aesthetic aspects of town and country landscapes with the help of large-scale maps, first used in local geographical work.

The value and significance of geography as a liberal study, its key position as a linking subject and its direct relevance to technological studies suggest that careful consideration should be given to its inclusion in technical courses at all levels, including those leading to the Diploma in Technology.

FROM THE *JOURNAL* A HUNDRED YEARS AGO

THE FOLLOWING extract is taken from a paper read to the Society on 22 February 1858 by Cyril C. Graham, entitled "Explorations in the Desert East of the Haurán and in the Ancient Land of Bashan." *Journal of the Royal Geographical Society*, Vol. 28, pp. 227–8.

It may seem strange, now so many travellers annually visit Palestine, that some important advances should not be made every year in our knowledge of the country. But the very system of travelling, as it is generally pursued in the East, is calculated not only to be of no value scientifically, but even rather to mislead. Few travellers devote so long as six weeks to the whole of Palestine, including a journey to Damascus, many only three or four weeks; during that time they are entirely in the hands of a "terjimán," or "interpreter," who knows enough of their language to understand the commonest remarks made to him, and by answering with great readiness to queries about things of daily occurrence, and making a point of always pretending to understand everything, he leads his employers into the belief that he is really well acquainted with the language he professes; whereas in the majority of instances he has but a very confused idea of the purport of their questions, but he always has cunning enough to give some apparently satisfactory answer, which the deluded traveller carefully notes down, and thinks he has obtained some valuable information. In this way any site which you are particularly anxious to find may be discovered without any difficulty. Only ask, or get your dragoman to ask, if there be not a place called "so-and-so" somewhere near, you are sure to be told "Yes!" And when you ask where, the fellow will stretch out his arm and point "over there." Well, if you are satisfied with this degree of accuracy, you put down in your journal for the day, that the long lost site lies in such a position. "We did not visit it, as it was a little out of our road, but it is well known to all the Arabs by its original name." If you are more enquiring, you desire to be taken to the spot. Then you are either led about till it is quite dark, and you are quite tired, and the guide pretends to lose his way, and you return with still this consolation that you have been near the spot, or else you are at once shown a site which your dragoman and the guide swear by the most solemn oaths to be the spot, bearing the identical name you mentioned. This may appear rather overdrawn, but I think those who have been long in the East will not think it is a caricature of Oriental travel. I have seen so many mistakes made in this way by travellers, and have read so frequently in books of "Eastern Travel," things which have evidently been palmed off on the writer—and usually all may be traced to the dragoman—that I feel it is not unnecessary to caution travellers against relying too implicitly on the information of these people, and above all against the practice of putting "leading" questions.

If you want really to obtain information in the East it must be done in a most roundabout manner, and you must learn to become a skilful diplomatist before you can hope to be very certain of success.

I have made these remarks rather with a view of setting travellers on their guard against a very dishonest and designing class of men, who from being well dressed, and so far accomplished that they apparently are acquainted with three or four languages, lead those who are for the first time in the East, and very naturally too, to believe that these dragomans are a very superior class to what they really are, and to treat them with the regard due to educated men. They have taken advantage of all this, and in very many instances the dragoman is master instead of servant.

A PRACTICAL GEOGRAPHER

SIR HARRY JOHNSTON AND THE SCRAMBLE FOR AFRICA. By ROLAND OLIVER. *London: Chatto and Windus*, 1957. 8½×5½ *inches;* 368 *pages; maps, drawings, plates.* 30*s*

IN 1879, AT THE age of twenty-one, H. H. Johnston decided to make his own way in the world, and set out for Tunis. "It brought him to meteoric success and almost as meteoric decline. Brilliant gifts but little training, wide knowledge but no recognized qualifications, middle class origins unredeemed at any stage by an expensive education, these were the liabilities arising from his decision. And to them must be added one over which he had no control, a fully grown stature of five foot three inches with a rather high pitched voice adding to the impression of precocity in youth, but faintly ridiculous in maturity and middle age." In 1901 Johnston's active career in Africa ended, and his remaining years were spent in retirement, by no means idle but apart from his literary productions, singularly unrewarding. He failed in attempts to enter Parliament, and he had little success as a business man. The memorial tablet in Poling Church commemorates him as Administrator, Soldier, Explorer, Naturalist, Author and Painter. He wrote an Autobiography, and his brother published, in 1929, the 'Life and Letters' of Sir Harry Johnston. Both of these have been used by Dr. Oliver as well as much new material including letters, drawings, and paintings in the possession of the Society. The result is a book which, as its sub-title suggests, mainly relates Johnston the Administrator and the Soldier to "the Scramble for Africa," and says relatively little about the other sides of his life except when they fit into the main theme. None the less it is an admirable book, well written, well illustrated, scholarly, and full both of apt quotations and brilliant and often amusing comments.

Dr. Oliver's method is perhaps adequately illustrated by the chapter headings. The first two, "Twenty one years" and "Angola and the Congo" are self-explanatory except that the first includes an account of his first African journey, to Tunis. There is much about painting and anthropology and a clear indication of the political ideas that were forming in Johnston's mind. His next venture was a scientific expedition to East Africa sponsored by the Royal Society and the British Association. Its main object was to collect botanical specimens and in this it was successful. But the chapter describing it is headed "The mountain with the unrememberable name"—a phrase adapted from a sentence in a letter from Gladstone to Dilke expressing perplexity at proposals to annex lands near to Kilimanjaro; and the chapter itself is mainly concerned with Johnston's own political schemes in that area. The next chapter headed "A resolute but singularly lawless personage," a remark by Lord Salisbury, covers Johnston's period as vice-consul in West Africa, and again is largely concerned with political events. Johnston lived for much of his time on the island of Mondole, from which the Cameroon Mountain could be seen. His immediate chief, Consul Hewett, gave him little to do, and this enforced idleness was decisive—"as the year in which he made himself no longer merely the Vice-Consul with the interesting artistic and scientific accomplishments but one of the very small company of people who were thinking about the coming partition of Africa on a continental scale and who were thinking in advance of events. He was now thirty-four years old. He had already a record of travel in widely separated parts of Africa—Tunis, Angola, the Congo, East Africa and now West Africa—which in variety was unrivalled among his contemporaries. He had met many both of the men of action and of the men of affairs who had been most influential in moving the African scene—Stanley and Leopold, de Lesseps and Baring, Kirk and Burton. . . . He had witnessed the colonial aspirations of Frenchmen and Italians, Portuguese and Belgians, Germans

and Spaniards. He had scientific interests which covered the continent, the pursuit of which had given a range and accuracy to his geographical knowledge rare even among the most well-informed students and promoters of discovery. It remained that all this insight, all this varied expertise, should be formed into a synthesis projecting forward from the events of the past decade into that which was to come. It was just this synthesis which Johnston achieved in his solitude on Mondole" . . . One practical result of this "solitude" was the preparation of a map showing "How Africa should be divided" (H. H. J., 1886) now preserved in the Public Record Office. After two-and-a-half years in West Africa Johnston returned to England, found himself the centre of much interest, frequently visited the Foreign Office to discuss African matters, and in August 1888 wrote a long article in *The Times* entitled "Great Britain's policy in Africa, by an African Explorer" which Dr. Oliver describes as "perhaps the ablest, certainly the most direct and concise, piece of argument that Johnston ever wrote." Johnston had now made his mark, and in January 1889 he received a new appointment as British Consul in Mozambique.

The next four chapters deal with Johnston's work in Central Africa. The first is headed by a phrase from Lord Salisbury "He will be worse on land than at sea" in reference to Johnston's request for a gunboat. The second "A frightful menagerie" refers to Johnston's personnel who were to administer British Central Africa, Whites, Indians, Zanzibaris and Somalis, and the phrase was that of Rhodes. So too was that of the next chapter, "King Johnston over the Zambezi." These three chapters are full of most interesting political and scientific material. They reveal the widening of the tragic breach between Rhodes and Johnston, as well as the mastery of the latter over the problems, as he saw them, of the development of British interests in Nyasaland and the territories that surrounded it. The fourth chapter headed "A most valuable life," marks the end of his career in Central Africa, and is the judgment of Lord Salisbury. It refers to Johnston's third attack of blackwater fever. Johnston stayed on, and recovered, and it was not until May 1896 that he left for home. One verdict he gave before he left: "Our mission undoubtedly here is to raise the negro of Central Africa into a civilized nationality, for we can never hope to colonize the bulk of this country with the white race." And one practical thing he had done was to add one link—Nyasaland—to the chain of the Cape to Cairo extension of the British Empire which he had, before anyone else, envisaged. Johnston was back in England in July 1896, and within a year found himself once more in Tunis "just a little disenchanted with imperialism," the heading of the ninth chapter of the book. His post as Consul-General lasted until 1899 and gave Johnston opportunity to add to his literary production, and engage in further diplomatic activities. His appointment as Special Commissioner in Uganda followed, and as it turned out, was his last piece of active service to the British Government. It is covered in a chapter headed "The God-given task of subduing the earth," a phrase of Bishop Tucker, one of his staunchest supporters in that part of Africa. It is a long and remarkable story, full of romance, tragedy and triumph: it is a tribute to Johnston's vision that much of what he did lasted, without serious criticism or dispute, for fifty years.

Geographers owe a substantial debt to Johnston for two major contributions to the subject. First he was a practical geographer in the widest sense of the word. In all his administrative work, in planning a campaign, or thinking out future developments, or assessing the natural wealth of a country, he had the geographer's eye for a country and his sense of its realities. Although this book is primarily occupied with political history, it none the less reveals the contribution which Johnston made to political geography both during his life in Africa and after his retirement.

Johnston's second contribution was made without perhaps his realization of what he was doing. He was one of the pioneers of that "new" geography which begins soon after the date of his birth. His various works on African exploration alone covered a wide field—Livingstone, Grenfell and the explorers of the Nile Basin. His historical works covered the whole of Africa, and explorers of all nationalities. His

detailed studies of the Congo, Central Africa, Uganda and Liberia furnished accurate information about the geography of those regions unobtainable elsewhere. These books were not easy reading, and were not intended to be popular and some of them were not wholly written by him. None the less among the forty books he wrote they stand out as a massive and unique contribution by an Englishman to the geography of the continent and to geographical literature as a whole. J. N. L. BAKER

SCIENTIFIC RESEARCH IN ANTARCTICA

NORWEGIAN-BRITISH-SWEDISH ANTARCTIC EXPEDITION, 1949–52. SCIENTIFIC RESULTS. *Oslo: Norsk Polarinstitutt*, 1956–7. $11\frac{3}{4} \times 8\frac{1}{4}$ *inches; diagrams and plates*

Vol. I, METEOROLOGY: *Part 2*, Surface observations; *Sub-part A*, Air pressure. By V. HISDAL, O. AMBLE, and N. J. SCHUMACHER, 64 *pages*, 1956.

Vol. II, METEOROLOGY: *Part 1*, Energy exchange of an Antarctic snowfield. *Sub-part A*, Short-wave radiation, 1956; *Sub-part B*, Long-wave radiation and radiation balance, 1956; *Sub-part C*, Wind structure in the low layer, 1957; *Sub-part D*, Surface inversions and turbulent heat transfer, 1957. By G. H. LILJEQUIST, 298 *pages*.

Vol. II, METEOROLOGY, *Part 2*, Special studies. *Sub-part A*, Halo-phenomena and ice crystals. By G. H. LILJEQUIST, 85 *pages*, 1956.

THESE SIX SUB-PARTS or papers are the first of a series of thirty-two publications which are planned to cover the scientific work of the very successful expedition to Dronning Maud Land. At a glance it is not easy to see how the six papers fit into a plan because the sub-part letters have been omitted from their light-blue paper covers. The provisional plan is an ambitious one; there are to be six volumes, two on meteorology, three on glaciology, and one volume on geology and topography. But it is six years since the expedition was in the field, many of its members have since joined other expeditions, and five of the six papers have been written by one tenacious member, G. H. Liljequist. Judging by the performance of other expeditions it can only be a pious hope that all the thirty-two papers will appear. However, it was an exceptionally good expedition; the long delay in its departure proved a blessing in disguise and afforded ample time for the preparation of its scientific equipment, so we can only hope that it will prove exceptional in its publication record and become a model expedition in all respects.

Each paper is well set out and illustrated; the instruments and their calibrations, troubles and problems are described and the analysis of the results are presented with a minimum of tables and graphs. Ample reference is made to other work and each paper closes with a summary. The English is surprisingly good, but there are a few errors in proof reading.

The four papers by Liljequist on the energy changes of an Antarctic snowfield are an excellent treatment of this phase of his work and should be studied by anyone contemplating similar studies. The work follows the path laid out by the late Professor H. U. Sverdrup during the *Maud* expedition of 1918–25 and followed by many other scientists, but the present work is probably the most comprehensive which has been carried out so far in an area where the snow surface is consistently below 0° C. The snow surface is then very adaptable to the air temperature, quite contrary to the condition common in much of the Arctic where in summer the snow is held at the melting point by warm air.

The monograph on short-wave radiation covers the following aspects: direct solar radiation, global radiation, albedo of snow, and penetration of light into snow. The direct solar radiation, the global radiation and the diffuse sky radiation were measured with good instruments well known to meteorologists and a careful check was kept on their accuracy at every stage. But the directional and global selenium cell photometers, used for a number of interesting studies such as sky brightness distribution, diffuse daylight in winter and light penetration into snow, appear to have been improvised and their accuracy is not so good. Nevertheless they give some useful first measurements and should be followed up by others.

Measurements of the direct solar radiation, its extinction by scattering and absorption by water vapour, enabled "normal" values to be determined. From these the intensity of the clear sky global radiation was calculated and integrated to give daily values. The latter agree well with those measured directly. The Antarctic air is so clean and dry that most of the year the clear sky insolation is about 83 per cent. of that which would be received without an atmosphere. Corresponding values with overcast sky vary from about 52 to 67 per cent. compared with about 23 per cent. in temperate latitudes. With partial overcast a relation was obtained with the sunshine duration measured with a Campbell-Stokes recorder. All these data are considered to be applicable to the fringe of the whole Antarctic continent.

Some measurements of the angular distribution of daylight, made with a photoelectric cell with an aperture of 15 degrees during dense overcast, and when open water off-shore produced the well-known "water sky," are very interesting. Looking towards the coast the sky brightness reduces to about a half the almost uniform value seen looking inland. The uniform intensity seen inland is the treacherous "whiteout" condition when all shadows disappear, and the observations are some first confirmations of theoretical work by Fritz. Further work with filters may enable spectacles to be developed which would distinguish surface features and reduce the risk of accidents in flying and surface travel.

Values of albedo with overcast were 85–90 per cent. In fair summer weather the albedo varied with solar altitude from 75 to 85 per cent., the lower values being due to larger snow crystals rather than thawing. A few measurements with a photometric cell and filters shows that selective multiple reflections between cloud and snow account for the high albedo with overcast sky. Data for the penetration of blue light into the snow were obtained, and down to a depth of 15 centimetres 40 per cent. was reflected. This shows the dependance of the albedo on the condition of the snow below the surface. It also explains how the only thawing which ever happened occurred some 3 centimetres below the surface. The incoming radiation is distributed in depth but the net outgoing long-wave radiation leaves from the snow surface only. There is evidently a need for a much more detailed study of the depth distribution of fluxes of different wavelengths and of the associated heat conduction in snow.

A direct measure of the radiation balance was not possible because the instrument motor would not function in the cold, consequently the Ångström pyrgeometer could only be used to measure separately the long-wave radiation in the winter darkness. Liljequist, in his second paper, gives an analysis of the long-wave radiation from the snow surface in relation to the different atmospheric conditions and particularly of the pronounced effect of a temperature inversion in fine weather. A linear correlation is found with low wind speeds and a marked increase occurs when the wind exceeds about 7 m./sec. and the inversion practically disappears. An empirical relation is obtained between the atmospheric long-wave radiation in fine weather, the magnitude of the temperature inversion, and the humidity. As the methods available for measuring the humidity at low temperature at that time were far from satisfactory the humidity relation is approximate.

From these data the annual and diurnal variation of the net long-wave radiation is computed approximately, and this is assembled with the short-wave and albedo

results in the previous paper to estimate the net monthly total radiation balance and its diurnal variation at the snow surface. There is a net loss of radiation on the average; the only period of net income is for about two and a half months in the summer, and that would evaporate only about 4 centimetres of snow. This small net income in summer agrees quite well with the only other measurement in a comparable area, namely the one made by Loewe, using a radiation balance meter, at Port Martin in Terre Adélie. The drastic change in the radiation balance which would occur if warm air caused snow melting and reduced the albedo is stressed. Apparently this happens in some years, for some of the deeper snow layers showed evidence of soaking with meltwater. Thus, to obtain noticeable thinning of the Antarctic ice there must be a radical change in the atmospheric circulation.

In the third paper the wind structure laws and the turbulent heat transfer relation during a temperature inversion are developed. The wind and temperature gradients were measured to a height of 10 metres above the snow surface by means of six recording cup anemometers and five platinum resistance thermometers fixed to a mast. With neutral stability, which generally developed in the winter under dense overcast, and in the strong radiation of summer, the wind speed was a logarithmic function of the height. As stability increased the wind profile became more and more linear, and a more general relationship with a logarithmic and a linear component was established empirically in the field.

Analysis of the surface roughness, and some interesting observations on the drifting of snow, lead to the result that, above a speed of about 13 m./sec., the density of the drift at lower levels increases with the fifth power of the wind speed. This rate of increase is much steeper than the cubic relation Bagnold found for drifting desert sand and the difference seems to need an investigation.

The turbulent heat flux is shown to be proportional to the wind speed at a reference level and independent of the temperature gradient when there is a well-developed temperature inversion, *i.e.* greater than 0·25° C./m. This is confirmed during the winter by observations of the net long-wave radiation from the snow and the heat conduction upwards through the snow.

In the last paper of the group of four, the nature of the surface temperature inversions are discussed in great detail and the work concludes with the monthly heat budget. The prime cause of the inversions and of their persistence in winter is the net radiation loss from the snow, which cannot be replaced by heat conduction from below the surface on account of its low conductivity. For this reason Liljequist calls them *radiation inversions* to distinguish them from the *advection inversions*. The latter, common in the Arctic, are more or less independent of the radiation and are maintained by warm air flowing over a snow surface constantly at the melting point. The turbulent heat involved in maintaining a radiation inversion is, in contrast to the other type, quite small. In effect, the snow in the Antarctic winter protects itself and the overlying air from heavy heat losses by building up a very adaptable blanket of cold air.

Over the year there is a small net loss of energy from the snow, suggesting a net sublimation of hoar frost equivalent to about 2·4 centimetres of water. The actual losses occur between mid-February and mid-October and the gain in summer could not give rise to more than 3·4 centimetres of water being evaporated from the snow. The annual snow accumulation amounted to some 35 centimetres of water, but confirmation of the amounts of sublimation and evaporation must await the glaciologists reports.

Evidently, the snowfall, about which we know so little, is the main climatic element in the present budget of the Antarctic ice sheet, and the budget is mainly expended by the blowing of the snow and the plastic flow of the ice into the warm sea surrounding the continent.

Liljequist's other paper on halos and ice crystals is of special interest to anyone who has witnessed these fascinating atmospheric phenomena. Just a few of the halo

illustrations in colour would have added to the interest. However, this is not a picture book, but a good summary of the present knowledge and a systematic study of the incidence and properties of halos seen during the expedition. An appendix gives full details of all the finest displays and the properties of ice crystals collected in low level frost-mist haloes. More halo-days were recorded than for anywhere else in the Polar regions but the reviewer was surprised to find that Paris holds the record with 176 halo-days in 1907.

Halos are formed when solar or lunar light is refracted and/or reflected by ice crystals in the sky and concentrated in certain directions. The concentration pattern depends on the type of ice crystals and their orientations as they float or oscillate in the air. Fog bows, which are sometimes confused with halos, are produced by water droplets, not ice crystals, yet fog bows were observed down to a temperature of −28° C., a considerable degree of supercooling. The interest of the meteorologist in halos arises because it is possible by systematic study to infer the types of ice crystals, and even the frequency of the different types of crystal from visual observation of the halo pattern. The present paper makes a useful contribution to this study. A Hall's halo with a mock sun upon it below the true sun appears to be a first record.

Barometric air pressure observations were made every three hours and the first section of the air pressure paper by V. Hisdal is concerned with a statistical description of their variations. The second section by V. Hisdal and O. Amble gives a harmonic analysis of the pressure variations and their correlations with tidal phenomena. The station, being on an ice shelf, moved with the tide, and a correlation was found in the air pressure variations with one of the tidal components. There does not appear to be a correlation between the twenty-four-hourly period and the daily temperature variation. Attention is drawn to the need for analysing air pressure data from the weather ships, and from lightships and neighbouring land stations, in order to obtain a better knowledge of the tides in open seas. This seems to have hampered further analysis of the present data. This paper will be studied closely by the few specialists in this field and the writer is not one of them.

Since writing the above and in the course of going to press, the reviewer has received the first two sub-parts, A and B, of Vol. III on glaciology, written by Charles Swithinbank. They should be particularly useful for those at present working or contemplating work in the Antarctic, and will be reviewed as soon as more of the glaciological results are published. W. H. WARD

REVIEWS

EUROPE

LEICESTERSHIRE. By W. G. HOSKINS. Making of the English landscape series. *London: Hodder and Stoughton*, 1957. 7×9 *inches;* 138 *pages; maps, plans, plates.* 25*s*

Dr. W. G. Hoskins' introductory volume to this series of books on the making of the English landscape was the subject of a review article in the *Journal* by Professor E. G. R. Taylor (*Geogr. J.*, **121** (1955), pp. 511–13). The latest addition to the series is by the same author, the general editor, and has been published after three similar works on Cornwall, Lancashire and Gloucestershire. Dr. Hoskins claims that his book is the fruit of twenty years of residence in village or city in Leicestershire. This "illustrative history of the landscape" is pleasantly written and attractively illustrated with over a hundred photographs, only one of which appears to have been taken by the author himself.

The book follows a similar pattern to that of the other volumes in the series. After two chapters on villages and two more on country houses and peasant buildings the author turns to towns, enclosures and communications, and provides a final chapter on the landscape of today. Professor Taylor said of the introductory volume that "geography is hardly mentioned or considered throughout the book," and the same criticism is equally true of this work on Leicestershire. Dr. Hoskins has the gift of stimulating his readers by historical explanations of what he sees. It is all the more unfortunate that he chooses almost to ignore the physical interpretation of the landscape. Also, as the book is so lavishly illustrated it is surprising that more and better maps are not included. Dr. Hoskins is no lover of the industrial scene and remarks that "the Leicestershire industrial landscape nowhere attains the grandeur of the North, or the dramatic and demented ugliness of the Potteries or the Black Country."

E. W. GILBERT

DIE KULTURLANDSCHAFT: Methoden der Forschung und das Beispiel Nordostenglands. By HARALD UHLIG. *Köln: Geog. Inst. der Universität*, 1956. $9\frac{1}{2}\times6\frac{1}{2}$ *inches;* 355 *pages; maps and plates*

The first third of this study on the cultural landscape of north-eastern England discusses existing concepts and research methods as emerging from German and English work; the remaining two-thirds is concerned with an analysis of the cultural landscapes within the area of Sheet 78 (Newcastle), One-inch Ordnance Survey (Seventh Series).

The first part reviews current work on "landscape" and *Landschaft* and relates the cultural landscape to its natural substratum as well as to the formative social groups. Emphasis is put on an evolutionary approach which penetrates from the observations of material features to the underlying economic and social forces and sees the landscape as an accumulation of successive and partly altered historical "layers," each period producing its own "landscape style."

While such theoretical discussion, though relevant, inevitably goes over a good deal of familiar ground, the actual investigation of the Newcastle area in the second part is more valuable and interesting in methods and results. Based essentially on the study of the vertical air photographs of the area and on field observations, it starts by recording the morphological detail in a map on the 1-inch scale, and in turn analyses the different layers from the pre-Anglian to the modern period. In each case an assessment of formative economic and social forces leads to a functional and morphological examination of the landscape and its residual features today. A vivid picture of this historical coalfield emerges in all its dynamic nature and complexity,

made coherent at the end in a scheme of broad evolutionary types of cultural landscapes shown on a separate map. The study is supported by annotated air and ground photographs and by an extensive bibliography.

In the regional part the author has made a contribution not only towards the geography of the area but also towards our general understanding of cultural landscapes and their geographical arrangement. It would be a pity if the rather abstract first part of the book, the overburdened German syntax of much of the text and some infelicities in the rendering of the English summary, were to prevent geographers in this country from taking careful note of this study. M. R. G. CONZEN

IRISH FOLK WAYS. By E. ESTYN EVANS. *London: Routledge and Kegan Paul*, 1957. 8½×5½ *inches; 324 pages; map, plates, drawings.* 35*s*

A wide circle of readers will enjoy this book. It is an archaeological and anthropological study of farm implements, walls, houses, fishing gear and boats, together with the customs and manners of the peasants. Typical chapter headings are "the thatched house," "pots and pans," "cars and carts," "boats and fishing," "fairs and gatherings" and even "old pishrogues." The author's 'Irish heritage,' described in the preface as "necessarily speculative and undocumented," delighted large numbers of people and this new book adds the findings of fifteen years additional field-work, in which guard has been kept "against the countryman's facility of speech, his poetic licence and his fatal desire to please." Use has also been made of a number of documentary sources, though it is held that in exploring the living past "one cannot employ the strict methodology of the historical or natural sciences." A useful bibliography is given, though in the sections on fairs and markets use could well have been made of the excellent report of the 1853 Commission.

Several maps, a large number of sketches and some well-chosen photographs enliven the text. The map on p. 136 showing twenty-one types of spade scattered over the country is rather more illuminating than the map with seven milk churns on p. 96; and both show the need for more regional mapping. "Some landscape features" on p. 19 on a geological basis does little to show the rich physical variety of the Irish scene. It is the sketches which lead one along the road to the field, to the farm and farmhouse, or to the fishermen and seaweed-gatherers on the shore.

T. W. FREEMAN

WALES FROM THE AIR. By G. MELVYN HOWE. *Cardiff: University of Wales Press*, 1957. 9½×7½ *inches; 42 pages of text, 42 plates.* 15*s*

As the title suggests, this book presents a selection of air views of the Welsh countryside. All the photographs are obliques, well reproduced on art paper, and carefully chosen to illustrate the range and variety of the physical and cultural landscape of Wales. A page of supporting text faces each photograph and skilfully gives the essential historical and geographical background to enable a full appreciation and interpretation of the illustration to be made. Many of the photographs reveal aspects of the geography of Wales that are not easily brought to life from a map study—the great uninhabited expanses of Cardiganshire, Radnor and Brecknockshire; Celtic, Anglo-Saxon and other field patterns; the coastal peneplanes and majestic splendour of the mountains of North Wales; small market towns nestling in secluded valleys and the castellated fortresses of Anglo-Norman origin. The selection of photographs is very representative and covers all the major geographic aspects of the Principality. The book will clearly be of great value to teachers of geography both within and outside Wales, and it should also appeal to the layman with Welsh interests, for the explanatory text is written in an easy style. The book presents a great deal of the basic geographic data of Wales in a novel and stimulating way, and should do much to encourage a greater interest in the nature and evolution of the landscape. Similar selections with appropriate geographic commentaries would no doubt be equally welcome for other parts of the British Isles. W. G. V. BALCHIN

EUROPE: THE EMERGENCE OF AN IDEA. By DENYS HAY. *Thomas Nelson for Edinburgh University Press*, 1957. $8\frac{1}{4} \times 5\frac{1}{2}$ *inches;* xi+132 *pages; plates.* 12*s* 6*d*

In this fascinating essay the professor of medieval history at the University of Edinburgh traces the idea of Europe from classical antiquity until the early eighteenth century. When it is recalled how variously geographers and others today conceive the territorial extent of our continent, it is the more worth-while and interesting to discover how the concept "Europe" emerged and what it denoted historically. The concept, of course, meant little or nothing except to the learned and literary folk of past times, but Professor Hay has been at pains to search for the occurrence of the term in surviving texts, from its origin in the Greek myth of Europa and the bull (alias Zeus) to its uses in medieval and Renaissance writings. Nor has he neglected the portrayal of Europe by cartographers.

We are invited to abandon the old derivation of "Europe" from the Semitic *erib*, meaning the land of "sunset" or "darkness," in favour of one from Greek with the meaning of "broadfaced": "Europe" was at first applied to the mainland as seen from the Greek islands. As part of the tripartite world of the Greeks, so represented in their T–O maps, Europe stopped at the Don. It had only a continental sense to Greeks and Romans and the concepts of Empire and later of Christendom were the more meaningful and emotive concepts. Only parts of Europe, as conventionally delimited, were ever political or cultural units. "Christendom," as distinct from "Church," came to have "profound emotional undertones" during the Middle Ages and, in reaction to external dangers from Moslem enemies—in turn Arabs and Moors and Turks (Seljuk and Ottoman)—"Christendom" came to comprehend members of both the Roman and Greek Orthodox churches. Indeed, although Christianity sought to win over the whole of mankind, "Christendom" came to be related essentially to "Europe," and the latter term became more used when the geographical discoveries of the late fifteenth century and the work of the Renaissance cartographers revealed a wider world. But the eastern limit of Europe remains in doubt, reflecting the gradual changes in the land and its scale eastwards from peninsular Europe, as the forests extend, and, beyond the Pripet marshes to the south, looms the steppe.

W. G. EAST

DE COLBERT À NORMANDIE: études et souvenirs maritimes. By HENRI CANGARDEL. *Paris: Nouvelles Éditions Latines*, 1957. $5\frac{1}{2} \times 9$ *inches;* 317 *pages; plans and plates*

M. Henri Cangardel joined the Commissariat de la Marine in 1902 and since then has worked to further the advancement of French shipping and all that is connected with it. The life and work of Jean-Baptiste Colbert (1619–83) have been his constant inspiration in his own years of service and the story of Colbert is told in the first part of this volume. "Keep papers in order, take a pride in this and reflect on all things concerning seafaring. Write directions yourself . . . do not let them remain on your desk. See they are executed promptly." This was the advice of Colbert, whose contribution to the building up of the French fleet is very great, and whose influence can be traced through to modern times. Benefits he originated have been extended and brought up to date: he founded schools in many coastal towns to provide ships' officers with free tuition in mathematics, astronomy for use in navigation, and other useful knowledge. These schools formed the Écoles d'Hydrographie and remained basically the same for two centuries. Colbert also advocated compensation for those who spend a large part of their time away from home in uncomfortable, if not dangerous, places. M. Cangardel has himself worked as Colbert did, for the betterment of sailors, ships and ports.

Protection of the home fleet is discussed at length and examples are given of measures taken by other countries to encourage the use of their own vessels. Ways of selecting and training recruits for the marine in the major seafaring nations are

compared. It is vital to attract the best possible men, for the merchant marine is a witness to the foreigner both of a country's strength and its weakness. "Our ships carry with them wherever they sail our language, our customs, our way of life and thought. They carry our goods and our passengers; they are the living symbol of the distant motherland." The vital importance in a nation's economy of shipping statistics—"they should be watched by governments as a sick man's temperature is watched by a doctor"—is ably demonstrated, and the author stresses the importance of coordination and cooperation of all methods of transport to the general benefit. This engrossing volume concludes with the story of the *Normandie* and her tragic end in 1942. There are many useful tables and statistics, and there are photographic illustrations of well-known vessels.

A. C. O'DELL

COAST LAPP SOCIETY: I. A study of neighbourhood in Revsbotn fiord. By ROBERT PAINE. *Tromsø Museum Schrifter* IV, 1957. 7×10½ *inches;* 341 *pages; maps, plans, plates*

Norway is experiencing a minor invasion of physical and social scientists from Britain. Physical geographers from Cambridge have taken over a glacier, at least one human geographer from Oxford has adopted a fiord settlement, geologists from London have annexed tracts in high Nordland. Ian Whittaker has analysed the social relations of a "nomadic Lappish community"; J. A. Barnes has investigated an isolated fishing group. The latest British monograph is by Robert Paine. The first volume of his survey of a neighbourhood unit in Revsbotn fiord has been published with the aid of a grant from the Norwegian Research Council for Sciences and Humanities. Great-grandfathers like Sir Humphrey Davy, who "discovered" Norway for the British, would heartily approve of the spirit of enquiry which carries a rising generation of investigators to its fells and fiords.

The Revsbotn community, where Robert Paine made his field studies between 1951–3, is a coastal Lapp group. Revsbotn is one of the smaller fiords of western Finnmark: its community consisted of thirty-five homesteads and forty-five householders. Although written in the idiom of an anthropologist, the human geographer cannot fail to be absorbed by this account of a peripheral Lapp community which has "come down in the world" from the mountains. The detail of adjustment to land and to sea, and the economic changes which have altered so much of Finnmark so fundamentally in recent years, bring Robert Paine to the heart of North Norwegian problems. These problems, moreover, have a significance beyond the community which he has studied.

The book is divided into two parts. Their titles, together with those of some of the subsections, are not very imaginative. The wealth of detail in the text, not all equally significant, might have been made more impressive by judicious pruning. Or would a more concentrated literary style have achieved an even more effective result? It is debatable whether the first person singular mixes very happily with the technical language employed and there are words which jar if used too frequently—fjordal, for example. It is a pity that the maps and diagrams are so limited in number since the material lends itself to this method of presentation. These are quibbles, however, which could be raised about a good many dissertations. The most important fact is that Robert Paine has had a valuable experience in Norway which has been made available to us. The second volume will be awaited with much interest by all who are fascinated by the Scandinavian northlands.

W. R. MEAD

RECENT SOVIET TRENDS: Proceedings of the Conference held at the University of Texas, October 11/12, 1956. Edited by George W. Hoffman. *Committee on Eastern European Studies, College of Arts and Sciences, The University of Texas,* 1957. 9×6 *inches;* 107 *pages*

This volume contains the text of five papers on matters of interest to students of Soviet affairs. Each paper is followed by a review by a member of the University of

Texas, together with an account of comments made during the subsequent discussion. Of particular interest to readers of this journal is Professor John A. Morrison's paper on "Geographic factors (and fancies) in Russian and Soviet expansion." In the course of a lucid historical description of this expansion Professor Morrison vigorously discounts the "urge to the sea" and "warm water" explanations of Russian expansion, as well as Sir Halford Mackinder's dictum that "who rules the Heartland commands the World Island." He seems to attribute Tsarist expansion to strategic and even religious reasons; but he offers no solution of the problem of future Soviet foreign policy beyond suggesting that the Soviet Union may aim at developing "a large export trade in manufactured goods" to enable it "to import the agricultural foodstuffs and raw materials to make up its domestic shortages." This aim was found to be unrealizable by Dr. Hodgman in his paper on "Soviet foreign and technical assistance." Other papers were by John Hazard on "Soviet law," Georges Bissonnette on "The Soviet Union since Stalin," and Lobanov-Rostovsky on "Trends of Soviet foreign policy in Asia." Taken as a whole this small volume is well arranged and provides much food for thought.

G. E. WHEELER

ORBIS TERRARUM EUROPÆ: Economic Map of Europe, by I. B. F. KORMOSS; Cultural Map, by PH. DUMONT and J. A. BALTUS. *Published under the patronage of the College of Europe, Bruges. Bruxelles: Les Éditions de Visscher, 1955. Brochure and folded maps in jacket 10×5½ inches; 220 Belgian francs. Each map separately with brochure 145 frs. In English and four other languages*

The moves to European unity have brought into being many new institutions. One of the most important of these is the College of Europe at Bruges, established in 1951 to give a year's training in European affairs to some thirty-five graduates drawn on a quota basis from free Europe. Geographical studies at this residential college are directed by Professor Le Lannou. These, and the need for maps and statistics of Europe as a whole, led Dr. Kormoss, one of the first graduates, to produce the economic map which, indeed, comprises sixteen maps on scales varying from 1 : 3,600,000 to 1 : 45,000,000. They are, therefore, rather small; but fine drawing and sharp colour-printing have yielded vivid maps of Europe's political and economic institutions, temperature and crop limits, distribution of population, fuel and power, steel, and of the various means of transport. Many of these maps are quite new, and most are not available elsewhere for all Europe—*e.g.* those of traffic on waterways, sea and inland port traffic, national and international rail traffic, electrified railways, electricity grids, etc. The maps are accompanied by thirty-four statistical tables and, here again, some of the material is not otherwise easily available for all Europe—*e.g.* figures of the main petroleum refineries and hydro-electric power plants.

The preparatory work was done in the face of formidable technical and financial difficulties, the latter necessitating great compression of material by the use of symbols and small scales. With patience, much valuable information can be abstracted from these maps but their main purpose should be to encourage consideration of Europe as a whole. Students of that continent will find it stimulating to study these original maps and comprehensive statistics of Europe as a unit.

The cultural map is not a student's tool but a beautiful pictorial map depicting over 200 of Europe's outstanding monuments. Important European institutions are also represented. A list of some 1500 eminent Europeans occupies the margins of the map, the names being grouped by profession and by the city in which they worked.

R. J. HARRISON CHURCH

ASIA

KURDS, TURKS AND ARABS: Politics, travel and research in north-eastern Iraq, 1919–1925. By C. J. EDMONDS. *London: Oxford University Press, 1957. 8½×5½ inches; xiii+457 pages; maps and plates. 42s*

Mr. Edmonds' book is a rich miscellany, corresponding with his long and varied experience of Iraq and especially of that part of Kurdistan which was to be included

in the new state. He first served in the Persian Gulf from 1912, but these pages relate only those formative years when the kingdom of Iraq came into being and attained its present bounds, a creative process in which the author honourably shared with many British diplomatists, soldiers, and civilians, whose achievements, forgotten or even vilified at present, can never be obliterated. Both chance and preference directed him to Southern Kurdistan, and here he opens a storehouse of information upon a country and people for which he conceived a deep affection, and upon which he is now a leading authority. Especially for an Englishman, as he says, it is a classic land, and he recalls with reverence the great nineteenth century names of Rich, Rawlinson, and Layard; the last of whom he does not often mention although, to the reader, his pages are instinct with reminders of that remarkable pioneer.

The thread running through this book is the political history which ended with the decision of the League of Nations that the *wilayat* of Mosul should eventually fall to Iraq and not to Turkey. Those were troubled years in Kurdistan, but trouble was in the blood and tradition of this people, whether under the long Turkish rule of yesterday or in far-distant centuries under the great kings of Assyria. The "Ranicol" and "Koicol" affairs, the elusive activities of Shaikh Mahmud, the marches, the flights, the sundry mishaps, the terrain, the punitive invasions and burnings, all might as well have been incidents in the "*n*th campaign" of some Assyrian king against just such other turbulent and elastic highlanders. Following a watercourse (p. 107), the "castle of Serochik" (109), *kalaks* (227), "Fish-hole, where there were some fine pools" (242), the knife-edge of a mountain, the car abandoned for the horse, and the horse for scrambling on foot (358)—all of these come, as it were, straight from the sculptures and inscriptions of Sennacherib. Indeed, the inhabitants also had (at least in the 1920's) altered little from what the hillmen had ever been, long before even the Assyrian empire—they had been Gutians, Kassites, Hurrians, Mannai. Now they are Kurds, with another racial admixture and another language (still "complicated," as Hammurabi observed of them), but their habitat was the same, and their old character and their old relations with the plains, peaceful or more often warlike, were not much different.

Antiquities are not the least of Mr. Edmonds' interests, but his great merit is the breadth of those interests and the scholarly diligence with which he has pursued them. Thus his study of the people has led him to trace the genealogies of several principal families, and to describe their religious sects, their costumes, and their popular poetry, of which he quotes many specimens, with his own translations; despite his modesty, these recall singularly in their sentiments and expressions similar translations from the Chinese. Above all his interest lies in the country, its scenery, which none of the rather undistinguished photographs worthily displays, and its topography, of which his descriptions are rather too minute for the reader to follow upon the four small outline maps provided. The illustrative part may, indeed, be called the chief insufficiency of a book eminently learned and instructive, but lively as well. For every reason as well as the administrative we rejoice that the author triumphantly avoided "the gravest political mistake a political officer can make [which] is to allow himself to be murdered."

C. J. GADD

THE JEWEL IN THE LOTUS: Recollections of an Indian Political. By SIR BASIL J. GOULD. *London: Chatto and Windus*, 1957. 9×5½ *inches;* xiv+252 *pages; maps and illustrations.* 25*s*

THE SPOTTED DEER. By J. H. WILLIAMS. Illustrated by STUART TRESILIAN. *London: Rupert Hart-Davis*, 1957. 9×5½ *inches;* 262 *pages; maps.* 21*s*

Sir Basil Gould was one of the odd thousand British who controlled and taught justice to nearly 400 million people, many of them violently quarrelsome, with hundreds of different religions and languages, and who kept the peace with the aid of armed forces which were of the ratio of only one armed man to about 4000 unarmed civilians. During his forty years in the Indian Civil Service Sir Basil was fortunate to

be constantly in the thick of historic happenings. He was in Delhi for the Durbar of 1911, in Persia during the Bolshevik threat after the First World War, on the North-west Frontier when the Fakir of Ipi was at the height of his power, in Kabul when Amanulla was deposed by Bacha Saqao, in Quetta for the great earthquake of 1935 (in which he was severely injured), and as the climax of his career, he was in Lhasa for the installation of the new Dalai Lama in 1940. A man of great versatility, Sir Basil played as hard as he worked. He was a keen shot, horseman and fisherman. He even sang in the chorus of 'The Country Girl' at the Gaiety Theatre in Simla. He had "green fingers" and made the plants and flowers grow wherever he went. He was a brilliant linguist, and one of the greatest authorities on Tibet, its religion and language. His narrative style tends to over-austerity and understatement, typical of an old Wykehamist, but he vies with Kipling in his capacity for condensing much into a few words, and there are passages of lyric beauty in his chapter on Bhutan. His account of the Delhi Durbar sounds like that of a bored official at a village garden fête, but there is poetry, humanity and warm sincerity when he tells of the installation of the Dalai Lama. One can detect the influence of Buddhism, which teaches the sublimation of all human emotion, when he dismisses the death of his wife in one brief sentence. His austere style gains by contrast with the fulsome and adulatory foreword by Sir Ernest Barker, which is supercharged with imagery and quotation.

Colonel J. H. Williams, better known as "Elephant Bill," in his book 'The spotted deer,' takes us to Burma and the Andaman Islands. The author gives no dates, but it is somewhere in the nineteen-thirties. There is a brief glimpse of the teak forests of Burma in the aftermath of the rebellion, the introduction of a newcomer to the timber trade and his philanderings with a Burmese girl, and the attempted murder of the author by a Burmese employee. Next come the preparations in Rangoon for a reconnaissance to the North Andamans, to find out the possibilities of extracting timber there and the employment of elephants or machines for the purpose; then the journey to Port Blair and the recruitment of convicts and the start of three months' adventure by sea and in the jungles of North Andaman. There is a great deal in the book for the student of timber economics, the botanist and the zoologist. The main theme of the book is quite different. The author has something to teach a crazy world in which men and ideologies sniff and snarl at one another like a pack of mongrels. He shows how trust in one's fellow men and understanding of the human heart gains far more than suspicion and threats. Against all advice he refuses to take guards with his convict labourers, gains their complete loyalty and gives them a new purpose in life. One of them is the man who tried to murder him. It is the same with his attitude towards animals. We are of course on the side of the elephants against the machines, and in the short dramatic episode of his encounter with the spotted deer he shows how trust will undermine fear. N. D. JENNINGS

TURKESTAN ALIVE. By BASIL DAVIDSON. *London: Cape*, 1957. 8×5½ *inches; 255 pages; maps, plates.* 25*s*

Mr. Basil Davidson has given us another readable book, readable because it conveys an authentic impression of the genius of Chinese Turkestan. We should be grateful for this, since the Sinkiang Uighur Autonomous Region, as it is now called, is a territory that few of us can ever hope to visit. "Chinese Turkestan," says Mr. Davidson, "must surely rank among the most handsome and exciting countries in the world." The Sinkiang landscape and the odd scenes along the road, in the eating-house or on the farm, are not overdrawn in the book but are so convincingly delineated as to prove how right is Mr. Davidson's claim for this little-known area.

The book is also readable because of the interesting people that cross its pages. Most of them are living personalities despite the fact that set pieces are put into their mouths that too often read like Chinese propaganda material, and too seldom like the sort of talk that would come naturally from uninhibited Kazakh horsemen or Uighur

farmers. That is a pity, for it would have been so much more instructive, as well as being of greater human interest, to know what the people of Sinkiang really were thinking and saying after seven years of Communist rule. The monotony with which Mr. Davidson's characters testify to the horrors of the past and the glories of the present becomes wearisome and tends to rob the book of its usefulness. One wonders if the influence of Mr. Tse Yun, the author's guide and "staunch friend of many miles," might not have a good deal to do with the views that various people are said to have expressed.

'Turkestan alive' is a readable book on account of its lively attempt to steer us through the complexities of Sinkiang's history and to indicate the lines of its present evolution into what is undoubtedly the largest experiment in "national minority autonomous government" yet launched by the Chinese People's Government. Whether the Uighurs we know today (who, by the way, have only been so designated since the 1930's) are the true descendants of the Uighurs of earlier centuries is a point that must be debated by Turcologists. The "Turkestan" that the book deals with is only that part of Turkestan that lies within China's western borders. The Uighurs form a majority of about 75 per cent. of the population. In the sense in which new forces and a new policy are at work there, the region is "alive" as it was not before. Mr. Davidson rightly claims that Sinkiang is now very closely bound to China, and it is a Chinese policy that is being worked out there. This policy is based upon the Chinese Communists' view that China is a multi-national state in which tendencies to "great-nation chauvinism" and "local nationalism" are equally abhorrent. The dominant Chinese element in the nation's life must not lord it over the minorities, neither must the minorities contemplate secession, even when their "autonomous regions" may lie next to long international borders with cognate races and common tongues on both sides—as in the case of Sinkiang. The reader must judge for himself whether the policy is not only successful but beneficial, or whether, in the long run, the indigenous peoples will be worse off than they were before. Mr. Davidson has only one view, but one feels that he is apt to suspend critical judgment. The book is illustrated with plenty of good photographs but could have done with a better map; and Sachow should have been spelt Suchow. W. J. D.

GEOLOGICAL MAPS AND SECTIONS OF SOUTH-WEST PERSIA: based on the work of the geological staff of the Anglo-Persian and Anglo-Iranian Oil Companies from 1909–1951. *London: British Petroleum Co.* (1957). *Scale* 1 : 1M. 25×36 *inches;* 17 *sheets*

The presentation of geological survey work in the form of abundantly illustrated folios was commonplace fifty years ago in the United States of America. Whilst it was probably the most effective method to grip and hold the attention of the intelligent layman to a geological theme the costs of production are high, too high for the powers that be, so that education, entertainment and the ideal were sacrificed to economy. Thereafter most regional geological results were packed up in dry-as-dust professional papers. The U.S. Geological Survey, however, allowed itself the luxury of publishing another folio on the Jurassic of North America and it was first on general display at the International Geological Congress in Mexico City in 1956. At the same time, in the same room, the folio on South-west Persia saw the light. This work consists of 19 pages with 6 transparent overlays sumptuously colour-printed and bound in an attractive green leather jacket. There are only 2 pages of print, 6 of colour-printed maps and 11 of horizontal and vertical sections. It represents an epitome of nearly fifty years of geological work in South-west Persia in which about 120 geologists have participated. The area covered is about 200,000 square miles. The folio is dedicated to the late George Martin Lees, Chief Geologist of the Anglo-Iranian Oil Company for twenty-three years.

It may be justly claimed that in no other published work is it possible to find so much objective, detailed and pertinent geological information about so large an area

of the earth's surface in so small a compass. The wealth of facts is augmented by a terse synthesis and the publication may well serve as the envy and despair of all geological executives who have to present to critics or a board a comprehensive survey of their own activities, but hardly ever does a chief geologist have to prepare for such a searching day of reckoning. If directors of national geological surveys for instance were to attempt such a review at the end of each half century and if their efforts were half as effective as those of the authors of the work under review, regional geological knowledge would advance by leaps and bounds; but many "grey hairs" would "go down in sorrow to the grave."

Page 1 of the folio, which is 35½ inches by 25 inches, provides an index and an analysis of the field-work done, recalling even the pioneers of the first decade of the twentieth century. The explanatory notes on page 2 tell when and how the work happened or was planned, starting with field surveys and reconnaissance and following through the growth of the organization to its complicated but effective state in 1951 when political *force majeure* brought the regime to its end. There is a history of the finding of Masjid-i-Sulaiman, the first field and the proof, ten years later, of where the oil was stored. The reviewer would give a different account of the birth of the second field, Naft Khaneh. The appalling losses of petrol transported in 4-gallon tins in 1917 made the finding of oil locally of vital tactical importance. Colonel A. T. Wilson sent G. W. Halse to the seepage area of Naft Khaneh in 1917 and he located the discovery well whilst his guard was involved in a skirmish. That this well was not completed until 1923 provides a measure of the trials and exasperations experienced by those assigned to outside tests in those far-off days.

The maps are printed in 23 colours and the choice is justified in the pragraphs on the lithological units. This brief chapter outlining the stratigraphy would, under less drastic editorship, have become unmanageable and might have been effectively buried in a corpulent text-book. Eight hundred words are devoted to structural notes and the Mountain Front—enough to stimulate the reader and make him aware of the many fascinating problems solved or involved. Finally the chapter referring to bibliography is curious, for it contains three items, two of them in French! The maps are on the scale of 1/1M and the structural features are emphasized on the transparent overlays which show anticlines, oilfields, faults and salt plugs. Here too is a plan of the Mountain Front with the position of the cross sections and vertical sections shown in relation to it. The 24 cross sections are on a scale 4 times that of the map and in the majority show structures which are observable or almost observable at the surface. Only in the last does the artist allow himself the liberty of depicting, far within the crust of the earth, what he would like to think is there, but which his experience warns him probably is not.

No one who has had a hand in Persian geological survey and reconnaissance can view this masterpiece without a glow of satisfaction and pride. There was even one act of ultimate good effected in its making. An aged "guide" from his hut in the valley climbed with a party to the spur above and looked out and around him. He raised his hands in prayer. "Oh Lord," he said, "I never knew your world was such a wonderful and large place."

J. V. HARRISON

AFRICA

DAVID LIVINGSTONE: his life and letters. By GEORGE SEAVER. *London: Lutterworth Press*, 1957. 9×5½ *inches; 650 pages; maps and illustrations.* 35*s*

To recall only the works on David Livingstone which have been published since the war (Coupland 1945, Macnair 1954, Debenham 1955, Simmons 1955) brings to mind the question of whether there is anything more that may be said of the greatest missionary and traveller in Africa. There are few men whose lives have received such detailed and extensive study (a bibliography of over two hundred books), there are fewer who have won such devotion from their biographers. Dr. Seaver makes this

latter fact one of the reasons for his work. He contends that in the past "an aura of hagiography" has tended to becloud the studies of Livingstone, except for those decidedly prejudiced against him. So long as there is no such prejudice it would be, seemingly, impossible to write of Livingstone without being fired in the imagination by his character and personality. Surely this is apparent in Dr. Seaver's own work, which yet maintains its objectivity. It is unjust and inaccurate for him to suggest that the judgments of scholars like Coupland and Debenham were made through "the refracted mists of sentiment"; one of the joys of Debenham's book is his deep feeling for Livingstone, of great warmth but always well balanced. Inevitably, Dr. Seaver has drawn considerably upon this recent work and even more so upon that of earlier writers. He has added some new material from the Central African Archives and from private correspondence. Of this, perhaps the most interesting are the extracts from the log of the *Lady Nyassa* during her crossing of the Indian Ocean from Quilimane to Bombay. What an audacious and intrepid voyage this was, its magnificence unfortunately (but inevitably) overshadowed by Livingstone's exploits on land in Africa!

Dr. Seaver's biography is altogether a notable contribution to studies of Livingstone, an attempt, with the aid of all the recently accumulated resources, to assess overall the man and his work. It was an immense task where one of Livingstone's stature is concerned, but nobly accomplished since the central figure is allowed so frequently (but with judicious selection) to speak for himself. The story is traced from early life, through the first missionary years, the discovery of Lake Ngami, the triumph of the great trans-continental journey, the disappointments of the Zambesi expedition, to the final grim tragedy of the last journeys. All in one way or another reflect the greatness of the man, who was by no means infallible and whose failings of character and temperament Dr. Seaver makes transparently clear with deep sympathy and understanding.

R. M. PROTHERO

PRINCES OF ZINJ. By GENESTA HAMILTON. *London: Hutchinson*, 1957. 8½×5½ *inches; 272 pages; plates, map.* 21*s*

The last sentence of Mrs. Huxley's foreword to this attractive book aptly sums it up: "Her lively narrative will help to recall the spicy air, the languid warmth and the friendly atmosphere of the isle of cloves to the memories of those who have been there, and to delight the mind's eye of those who have not." Lady Claud Hamilton's book is sheer delight. Her chief distinction, perhaps, is her power of descriptive detail, and her choice of the right detail to describe. She is equally happy with the sands of Muscat, and the tropical greenery of Zanzibar. The book can best be described as a literary history of Zanzibar and the Azanian coast since its occupation by the Royal House of Muscat. It is also, in parts, a vivid example of what happened when the scramble for Africa met another "imperialism" less well organized, but much better acclimatized than the rival powers of Europe. The authoress chronicles the ruthlessness of imperial Germany, and although her love for the Arabs and all the peoples of the coast is implicit throughout the book she relates the savagery of the Sultans, and the barbarities of the slavers, both with great understanding. What makes one rather sad is the picture she paints of the apparent chicanery of the British Government over the "leasing" of the Mombasa strip from the Sultan after he had been led to expect something else.

It is a pity such an excellent book has not been provided with a better map: the existing one stops south of Lamu where an important part of the story takes place. This book, by a real lover of Africa, and one who understands her subject, should be read by all who are interested in the history of East Africa. It touches on most of the aspects of the development of this part of the world, and it does it from an unusual and important angle, the angle of the Sultans of Zanzibar.

W. P. G. THOMSON

NORTH AND SOUTH AMERICA

THE INCOMPARABLE VALLEY and SEQUOIA NATIONAL PARK. By FRANÇOIS E. MATTHES, and edited by Fritiof Fryxell. *Berkeley: University of California Press*, 1957. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 160+136 *pages; plates.* 15*s each*

For over thirty years François E. Matthes devoted a considerable part of his professional and private life to the scientific study of the Sierra Nevada. His "Geologic history of the Yosemite Valley" (Professional Paper 160, U.S. Geological Survey) is deservedly held in high esteem. Unfortunately he did not live to write the "Yosemite book" he had planned for his retirement. These books edited by Fritiof Fryxell are an able attempt to fill the gap. They are well written, but not written down to that wider public which Matthes could not hope to reach with his professional work. If criticism can be made of the texts it is that occasionally the majesty of the scene leads to fulsomeness. This perhaps must be accepted as a price to be paid for the popularization of a technical theme. In 'The incomparable valley' the geological and geomorphological evolution of that spectacular feature is explained with the aid of 50 admirable plates and 10 figures. 'Sequoia National Park' as its sub-title "a geological album" suggests, comprises 124 plates each accompanied by a few lines of explanatory text. The former is a book for the interested visitor to Yosemite National Park, but its admirable photographs and lucid explanations permit it to be enjoyed by those not able to stand on Glacier Point and look across the deeply incised valley to the crest of the exfoliating Half Dome. Surely no one could fail in such a situation to ask how this mass of granite came to have that particular shape? The books do not avoid explanation, they are a model of popular geomorphological writing with a sound, scientific, genetic approach.

A most unfortunate deficiency is the absence of adequate maps. It is most annoying to read of this or that feature and not to have the faintest idea where it is in relation to others. This is not an uncommon failing in descriptions of landscape but no excuse can be permitted in the case of Yosemite as a beautiful relief map of the valley on the scale of 1 : 24,000 has been published. A folded copy or a simplified version of this could have been included at little extra cost. The tens of thousands who camp each summer on the old lake floor at the bottom of Yosemite valley, and watch the fire fall each night as it tumbles down the 3000-foot high valley wall from Glacier Point, now have an intelligent guide. The searchers after the redwoods have a pictorial guide which will be of greater value if they are already conversant with the Yosemite story. To us who must needs be chair-bound in our investigations of the Sierra Nevada, even though a modest dollar tourist allowance is now permitted, the books must suffice and they do their job well. E. H. BROWN

AMERICAN COMMODITY FLOW. By EDWARD L. ULLMAN. *Seattle: University of Washington Press*, 1957. $5\frac{1}{2} \times 8\frac{3}{4}$ *inches;* 215 *pages; maps.* $4

Professor Ullman is well known for his studies of American railway traffic movements and this volume, adding considerably to knowledge of American traffic, will add also to his reputation. This long series of maps is based on a 1 per cent. sample of waybill statistics and analyses traffic for twenty representative states. Unfortunately, there is an incomplete picture, in that to avoid disclosure of company business, statistics are not published where there are only a few shippers, and Professor Ullman draws attention to major alumina movements which are not reported. The first section deals with capacity of lines and such revealing railway operating features as location of marshalling yards. The main part of this work is the series of state traffic maps, and an important feature, revealed by this long series, is that the cost of movement tends to restrict traffic to adjoining states unless there are special factors such as the long haul of machinery from the north-east to non-industrial western regions. The illuminating conclusion is that while goods move more readily in the United States of America than across European frontiers, there is definitely not a nationwide

market for other than specialist producers. The last section is concerned with American ocean freight traffic. This volume is a lithographed production and might well serve as a model for British publishers of research material. The abundant diagrams are excellently reproduced, and only in the map on page 3 is the line work so fine as to render the map confused and unintelligible. A. C. O'DELL

THE NEW ELDORADO: VENEZUELA. By EDWARD WARD. *London: Robert Hale*, 1957. 8¾×5¾ *inches;* 189 *pages; illustrations.* 18*s*

VILLAGE AND PLANTATION LIFE IN NORTHEASTERN BRAZIL. By HARRY WILLIAM HUTCHINSON. *Seattle: University of Washington Press*, 1957. 8¾×5¾ *inches;* ix+199 *pages; maps and illustrations.* $3.50

Venezuela is changing so rapidly that it is good to have a first-hand account of the transformation which is taking place. In the capable hands of Edward Ward, experienced journalist and radio commentator, this account is a lively picture capturing the many highlights of its economic development in an attractive style. It is not, and is not intended to be, a penetrating analysis of the land and people, but the recorded observations of a traveller fascinated with the contrasts presented by life in the capital, the Andes, the Llanos and the Maracaibo basin. The up-to-date nature of the information and the total Venezuelan canvas it covers are its great merits. Mr. Ward did not rely on gathering impressions in Caracas, but saw the Guárico dam, the Caroní hydro-electric project and the iron mountain of Cerro Bolívar, and talked with the oil drillers of Lagunillas, the agricultural colonists of Turén and the Apure ranchers. So enthusiastic is his admiration for the speed of change, and for the abundant wealth which the petroleum royalties provide to carry forward the gigantic projects, that the uncritical reader may be persuaded that the country is not only an Eldorado but a Paradise in which even military dictatorship is accepted as the government "best adapted to Venezuela" (p. 182). This is a conveniently facile "solution" to the tragic story of its past, but one cannot help wondering why the Venezuelans must be deprived of democratic institutions to secure material progress. It is a dangerous justification we rightly condemn elsewhere. Nor, in a rapidly changing world, can dependence on petroleum for 94 per cent. of its exports be regarded as a basis for long-term economic stability.

The transitory nature of such boom economies is well drawn in Dr. Hutchinson's account of 'Village and plantation life in Northeastern Brazil.' This region, like Venezuela today, was once the world's largest exporter of a commodity in great demand. Now the decaying plantations and stately seventeenth century cathedral towns with their poor cabins and waterfront shanties are being annexed by new settlement growths dependent on absentee-managed sugar and cacao factory-estates, and on Petrobrás, working the only significant Brazilian oilfield.

Not since Gilberto Freyre's classic work on plantation life in the north-east have geographers been presented with such a fascinating and valuable analysis of the whole historical, social and economic basis of this region. Based on observation of and participation in the life of the community of Vila Recôncavo spread over two years in the period 1950–6, the work is a publication of the American Ethnological Society and is the second such monograph to result from research sponsored jointly by Columbia University and the State of Bahia (see 'Town and country in Brazil,' by Marvin Harris, reviewed in *Geogr. J.* **128** (1957), pp. 99–100). Dr. Hutchinson's investigations of the plantation, its settlement patterns, the social life of the rural and urban constituents, the formation of social and economic classes, the legacies of slavery, the declining impact of Catholicism, and recent changes in the area combine to give a picture of the human geography of old Brazil which students both in the systematic and regional fields will use for a long time to come. G. J. BUTLAND

AUSTRALASIAN TRAVEL

It is necessary to remember, when commenting on books about Australia or other countries where there is an interest by potential immigrants, that (other than official literature) one book chosen at random might represent the total reading of an uninformed immigrant. How, therefore, will he or she react to this book? I TRAVELLED A LONELY LAND, by Nina Pulliam (*Hale*, 1957, 21*s*) is very mixed and needs a considerable amount of perseverance to get past the early chapters on the basic points of lodging, drink, sport and attitudes. There is some good and original material about South and Western Australia and Tasmania, but a considerable part of the book does not offer a fresh approach to the familiar, nor is it presented any better than usual. The authoress is an American and tells her story to Americans; many comparisons are therefore limited in their application.

Inevitably RETURN TO THE ISLANDS (*John Murray*, 1957, 18*s*), is less instructive than 'A pattern of islands,' Sir Arthur Grimble's first book about the Gilbert and Ellis group. This does not mean that this book is lacking in interest or information, but 'A pattern of islands' contained so much about an almost unknown part of the world that any subsequent volume could only be a continuation of Sir Arthur's experiences. There is much to entertain and instruct the reader, and the text is enlivened with some attractive drawings by the late author's daughter. Among the experiences narrated a number of important points emerge: for instance, the result of the separation of a Colonial Officer from his family for the sake of the children's health and its attendant problems of finance; the problem of conveying to a simple people the mechanics of taxation; the impact of Christianity upon a pagan people; the problems created by the introduction of Chinese labour to work with Gilbertese at the phosphate works. Sir Arthur's death has robbed us of further volumes but we are grateful for what he has given us; his contribution to learning about a little-known region will be appreciated by travel book addicts and geographers alike.

CRUSOES OF SUNDAY ISLAND by Elsie K. Morton (*Bell*, 1957, 15*s*) is a very readable account of the trials of the Bell family on an island 600 miles to the north of New Zealand to which Tom Bell, his wife and six children moved in 1878. Bell was a man typical of the period—the despotic family head, but with the kind of courage and tenacity that built our Empire. The two eldest children, Hettie, eleven years of age on landing, and Bessie, nine, shared the hardships and physical discomfort of setting up home with their parents on this fertile island which seemed to be haunted by ill luck. The story was told by Bessie Bell to Miss Morton, a well-known New Zealand writer, who has presented this interesting desert island tale.

BEYOND AUSTRALIA'S CITIES by Bill Beatty (*Cassell*, 1956, 18*s*) begins well; the reader hopes that a conducted tour, adequately described, to the remoter parts of Australia is in store. The start, to Alice Springs, is effective, but the book subsequently becomes a series of jottings, each chapter obviously the result of some special search. Many of these chapters are instructive but some leave the reader feeling that the author need not have left a city to compile his story. The book is readable throughout and has a wide appeal, moreover it can be recommended widely as containing much useful and original material about lesser known parts of Australia; it does not pretend to be exhaustive. The inclusion of a map would have assisted in emphasizing the diversity within the country, as well as making the text clearer.

P. J. T. BARBARY

POLAR REGIONS

Of the six books on the Polar regions which come up for review, three are concerned with both North and South, one concentrates on a specific area of the Antarctic, one is a book of reminiscence in the same Antarctic area, and one a new Polar biography. Colin Bertram's ARCTIC AND ANTARCTIC: A PROSPECT OF THE POLAR REGIONS (*Cambridge, Heffer*, 1958, 21*s*) is a revised edition of a book first published in 1939. The

author has been a member of expeditions to both the Arctic and the Antarctic, and was Director of the Scott Polar Research Institute for seven years, so might well be expected to produce a worth-while book. He has more than justified these expectations, adding the pleasures of style and humour to knowledge and selection. The chapters on polar living, dogs, transport, food organization and leadership seem to contain all the interesting details about which most polar books are irritatingly silent. "Polar prospects today" is an additional chapter, and one that Dr. Bertram is well fitted to write. He reviews the spread and importance of national claims in polar regions, particularly in Antarctica and particularly since the International Geophysical Year has accelerated activities and increased the number of nations interested in these regions. The year 1957 he sees as a turning point in Antarctic history, but feels that no one can prophesy what, except for certain change, will follow it.

DISCOVERY OF THE POLES (*Penguin Books*, 1957. 3*s* 6*d*) by Quintin Riley and Richard Taylor is a Puffin Picture Book, an introduction to polar exploration for, one presumes, children. The text, which shares thirty pages with a generous number of illustrations, manages to achieve its purpose to a very reasonable degree, certainly more successfully than a number of more pretentious books that have appeared recently. The drawings, black-and-white and coloured, are spirited, imaginative and interesting, and there are some good sketch maps.

The reviewer may well be excused a tiny plaint of "Not yet another!" as he opens one more history of polar exploration. In his last book, FROM HUSKY TO SNO-CAT (*Staples*, 1957, 16*s*) the late Admiral Lord Mountevans has sketched the course of exploration of both the Arctic and the Antarctic regions in a simple and straightforward manner. There is no room for much detail in 140 pages, but that he should contrive to present a very respectable outline of his subject in so short a space is something of an achievement. There are also two introductory chapters on the International Geophysical Year, a mixed bag of good photographs, and helpful end maps.

Since 1947 the Australian Government has despatched annual expeditions to man permanent scientific stations in the Australian section of Antarctica; Heard Island, Macquarie Island, Mawson in Mac-Robertson Land and Davis in the Vestfold Hills. The scientific work is mainly meteorology, survey, geophysics and biology, and is carried out partly in the stations and partly during exploratory journeys by aircraft, ship and sledge. In ANARE (Australian National Antarctic Research Expeditions) Phillip Law and John Bechervaise set out to describe the background and activities of "Australian Antarctic outposts," and they have produced a book that is a delight to look at and to read. The text is well written and comprehensive, the photographs are admirably chosen, generous in number and beautifully reproduced, in fact the book is a model of its kind. Published by the Oxford University Press at Melbourne (1957), it is a bargain at 45*s*.

In SOUTH WITH MAWSON (*Angus and Robertson*, 1957, 18*s*) we are in much the same area nearly half a century ago. Charles Laseron, the author, was geologist on Mawson's Australian Antarctic Expedition of 1911–1914, and his book is a personal account of that venture. "Not," he writes, "a tale of wild adventure and hairbreadth escapes, nor were the hardships experienced unduly harsh. . . . Life is so very different in the polar regions that even the smallest detail looked at in retrospect is invested with a certain amount of interest and romance." This fairly epitomizes the contents of the majority of similar books and, while it would be churlish to grudge these authors the pleasures of happy reminiscence, the results seldom make very entertaining reading. Mr. Laseron's book is no exception; it is pleasantly written and there are moments of real interest, but on the whole it is unrewarding. This is the second edition and contains, we are told, an entirely new set of illustrations. It also contains a not very accurate end map of stations in the Antarctic during the International Geophysical Year.

Finally, a biography: NANSEN (*Longmans Green*, 1957, 30*s*), by Liv Nansen Høyer (translated from the Norwegian by Maurice Michael), has all the merits and weaknesses to be expected in the story of a well-loved father written by an uncritical daughter; it is warming, but not very stimulating. There are pleasant domestic portraits of the great man, and some interesting sidelights on his opinions of men and events; but, in general, the explorer, the scientist and statesman fail to emerge from the nursery background. L. M. FORBES

METEOROLOGY OF THE ANTARCTIC. EDITED BY M. P. VAN ROOY. Editorial Committee: T. E. W. Schumann, W. L. Hofmeyr, R. J. Venter. *Pretoria* (*Weather Bureau*), 1957. 12×10 *inches;* xi+240 *pages;* 8 *plates;* 24 *circumpolar charts; many tables and diagrams.* 60*s*

This is an important book, the first text book on the meteorology of the far south, a handsome volume which contains between its two covers more comprehensive information than any work known to the reviewer on the northern polar regions.

Its production by a group of South African meteorologists and one Australian, in association with the work of the Southern Hemisphere Daily Weather Analysis Project at Pretoria, has been a race against increasing knowledge, which ever since 1946 has come in almost daily and with increasing tempo. Revision in some years' time, when the work of the International Geophysical Year has been digested, appears inevitable. Yet meteorologists and workers in other disciplines concerned with the meteorology of the far south could not be kept waiting for this book, which contains a great array of information of permanent value.

To geographers, not the least attractive feature will be the map in the back cover, a layer-coloured contour map of Antarctica on a scale of 1 : 10M. Important spot heights (in metres) are added and the positions of expedition bases, past and present (1956) shown. This is in some ways the best map of Antarctica so far produced. The eight pages of pictures at the beginning will commend themselves to all, particularly to teachers.

The southern hemisphere atmospheric circulation is of special interest to meteorology because it represents the nearest approach we have to what the atmospheric circulation would be over a uniform earth devoid of geographical interference. There are still some geographical effects present, of course, in the southern hemisphere climates and in the general atmospheric circulation, reflecting particularly the influence of the high relief of the Andes and of Antarctica, the broad heated surface of Australia and the somewhat eccentric position of the main Antarctic ice region with respect to the pole.

The first chapter contains contour maps of most of the principal sub-Antarctic islands and of the surroundings of bases in Antarctica where topography may be important. For meteorologists who have to interpret observations which could have been influenced by local effects this is an excellent feature. A comparable gazetteer of Greenland and Arctic observation sites is a need which is still outstanding. The Falkland Islands, South Georgia and the South Orkneys have been omitted, probably because equivalent maps are available elsewhere.[1] However, no good contour map has yet been made available of Laurie Island, where the base established in 1903 by a Scottish Meteorological Society expedition, and since 1906 operated continuously by the Argentine meteorological service, provides the longest weather record from the far south.

Meteorology still awaits the exploitation of the well-placed South Sandwich Islands and of Bouvet Øya. Difficulty of access or of obtaining an adequate foothold for a base camp has so far hindered progress here. (If the International Geophysical Year activities in the far south are to be prolonged, something may nevertheless be achieved on these islands—possibly by the Russians. In this case the most important

[1] Pepper, J. 'The meteorology of the Falkland Islands and Dependencies 1944–50.' London (Crown Agents) 1954.

remaining gap in our scientific survey of the southern atmospheric circulation will be in the South Pacific, where the equivalent of a stationary weather ship making surface and upper air observations somewhere about lat. 55° S., long. 120° W. is badly needed but still appears to be a pipe dream.)

The broad geographical and oceanographic features of the Antarctic and sub-Antarctic are by now reasonably well known and are excellently treated in the book. The significance in connection with the Terre Adélie gales of the great, infinitely gently shelving basin indicated on the map in the configuration of the ice cap on the Terre Adélie side of the Pole does not seem to have been realized in time for inclusion in the book. This flat basin, or trough, between the highest part of the ice dome to the west and the Victoria Land mountains on the east is so placed as to channel towards the coast between long. 90° and 150° E., both the katabatic cold air drainage from a vast area and the general wind circulating around the semi-permanent anticyclones centred over the main ice dome near lat. 82° S., long. 60° E. Doubtless the form of the main declivity at the edge of the ice sheet in Terre Adélie determines the position of actual maximum gale frequency, but the geographical features mentioned explain the extraordinary dominance of strong south-easterly winds in the sector long. 90° to 150° E. Indeed, these winds were successfully used to predict the geography. The contour map of Antarctica reveals one further feature of great meteorological interest: the great lowland of the Ross-Weddell graben south-east of the Ross Sea must be of importance as a gathering ground for deep cold air masses and also explains the occasional establishment of a depression track south of lat. 80° S. from the Ross Sea to the Weddell Sea. Depressions on or near this track have often figured on the southern hemisphere weather charts drawn at Pretoria and probably accounted for the gales which afflicted both Scott and Shackleton on the nearby polar plateau. We have reason to believe that the 1957–8 Antarctic summer was more than usually free of depressions on this track—a happy circumstance for Sir Vivian Fuchs and Sir Edmund Hillary!

Various chapters deal with the climates of the Antarctic Ocean, islands, coastlands and continent as well as with the general meteorology and some tentative approaches to the important problems of radiation and precipitation balance. With so much basic data to present, though still far from complete, expressions of opinions and interpretations which might prove rash or premature have been easily avoided. Geographers as well as meteorologists may however be interested in the evidence that the eccentric position of Antarctica with respect to the pole affects air and ocean temperatures and the general atmospheric circulation, making the Indian Ocean sector the coldest sector. The formidable climatic gradient between tropical Mauritius (20° S.) and the Ice Age conditions at Kerguelen (49° S.) appears to be unequalled anywhere in the world, though it is approached also in the South Atlantic sector between Gough Island (40° S.) and Bouvet (54° S.).

Circumpolar maps of the regions south of lat. 45° S. provide remarkably informative surveys of many items, including ocean surface currents, convergences and ice limits, atmospheric pressure, temperature, precipitation and evaporation, cloudiness and the frequencies of sheet clouds (*stratiform*) and heap clouds (*cumuliform* types), resultant mean surface winds and general circulation patterns in the middle and upper troposphere. In some cases the maps are necessarily limited to the summer season and are unavoidably generalized over Antarctica.

Numerous tables of climatic (and some geographical) data mean that the book will be an invaluable reference for teaching and for research for many years to come.

Finally, one criticism: the omission of an index—no doubt as an economy measure—is a real hindrance to ready reference in spite of a good contents list and a well chosen 330-item bibliography with page references.

H. H. LAMB

PHYSICAL AND BIOLOGICAL

EARTHQUAKES. By G. A. EIBY. *London: Frederick Muller*, 1957. 8¼×5½ *inches*; 168 *pages; illustrations.* 21*s*

The author is geophysicist at the Seismological Observatory, Wellington, New Zealand. It is stated in the preface that this book has been written because of the absence of a suitable general text about earthquakes, but the ground covered is in fact very similar to that in a publication (mentioned in the author's appendix) of the same title written twenty-one years ago by N. H. Heck of the United States Coast and Geodetic Survey, which has lost none of its value during the lapse of time. The present volume is none the less most welcome since it gives a useful summary of information concerning the seismicity of New Zealand which is not easily available, except from specialized periodicals, in Europe. Moreover, the author utilizes the recent geophysical data from seismic and gravity studies regarding variations in thickness of the crustal layers. There is a well-balanced discussion of recording instruments, seismograph records, earth structure, seismic zones, and building design. The book ends with a brief description of some earthquakes in both hemispheres. Possibly because no earthquake in New Zealand has exceeded a magnitude of 7¾, the calamitous topographical changes arising from shocks such as Kansu (China) in 1920 and 1927, and Assam in 1950, have not been stressed, but the photographs convincingly demonstrate the seriousness of the smaller, but still very severe, shocks which do occur in New Zealand. As in other seismic areas, the public and architects of his country have short memories, and Mr. Eiby indicates that unsuitable structures continue to be built which invite damage from future shocks. The illustrations are for the most part excellent, in particular Heim's photograph of the Quiches seismic fault in the Peruvian Andes, and the air view of transcurrent faulting in a Californian orange grove. The geological diagrams are not altogether successful, and in the middle drawing of Figure 37 the elastic deformation is surely in an opposite sense to that indicated by the arrows. The caption of Plate XI states that the strata are horizontal, whereas in fact the photograph demonstrates a strike section of beds which appear to dip fairly steeply into the hill mass. These are, however, minor defects in a very readable and informative book. J. B. AUDEN

CLIMATOLOGY. 2nd edition. By W. G. KENDREW. *Oxford: Clarendon Press*, 1957. 8½×5½ *inches;* xvi+400 *pages; maps, diagrams*, 42*s*

This book contains much useful information. The first three sections deal with the distribution of temperature, wind and atmospheric water and with the various factors which determine these distributions. In the fourth section mountain and plateau climates are given special treatment and in the fifth section the weather systems of middle latitudes are described in some detail. In the last section four areas are selected to exemplify certain climatic types. The climates of the Sudan (Ethiopia to Senegal), the Mediterranean coastlands, Vancouver Island and Manitoba are described in fourteen pages.

While the traditional framework of descriptive, distributional climatology is retained, some introduction to the meteorological basis of climate is also given. An attempt is made to show that climatic means should be viewed in the light of changeable, day-to-day weather, explicable only in terms of air mass movement around migratory pressure systems. The frequent eye-witness accounts of weather situations experienced in different parts of the world are most stimulating but the insertion of dynamical meteorology into a "climatic belt" framework is not entirely successful. Systems such as "the warm anticyclone" are introduced without any valid description of their structure. The device of the isobaric surface is used but never referred to as such; it seems to be assumed that the reader understands both the technique and its significance but, at the same time, it is obvious that technical explanations are being avoided, presumably because this book is intended primarily for those who do not

understand physics. If valid explanations had to be avoided, simple descriptions of flow patterns would have been sufficient. Tentative "explanations" such as that for the sub-tropical high pressure belts should surely have been avoided. Furthermore the flow pattern is not always presented accurately; the myth of southern hemisphere air flowing across Indonesia and the inter-tropical convergence zone migrating deep into south-east Asia is perpetuated here despite all the contradictory evidence.

Air masses are introduced as a factor in the explanation of temperature distributions, not as the fundamental divisions of the troposphere whose properties and movements can be used to interpret the distribution of all the weather elements. Much of the repetition and disjointedness in this book arises because of this approach and much of the difficulty in regionalization stems from the same source. The adherence to lines of latitude as climatic boundaries obviously arises from mere necessity for subdivision and not from the recognition of valid correlations. The regional nomenclature is also unhelpful. The use of "the tropics" as distinct from "equatorial," though time-honoured, is nevertheless confusing in view of the terminology met by students in vegetation and soil studies. Also "the westerlies," as a climatic subdivision, is unfortunate in view of meteorological realities. It is particularly inept when used to include such areas as Manitoba. The plates in the book are of a very high standard and the numerous diagrams are, in the main, clear and helpful.

S. R. EYRE

ELEMENTS OF GEOGRAPHY, PHYSICAL AND CULTURAL. 4th edition. By V. C. FINCH, G. T. TREWARTHA, A. H. ROBINSON and E. H. HAMMOND. *London: McGraw-Hill*, 1957. 10×7½ *inches;* x+693 *pages; maps, diagrams, plates.* 56*s* 6*d*

The fact that this lavishly produced and well illustrated text book has gone into a 4th Edition is a sound indication of its worth. It will be of great value as a source of reference for sixth form teachers in this country and, if sufficient money were available, as a text book for some advanced sixth form pupils and first year University students. It deals with various elements of geography in a clear and comprehensive way but its great value is that it does not try to cover the world. It does, however, most successfully illustrate the elements of geography by emphasizing world patterns with a series of admirably chosen examples. As many of these come from North America, teachers in Britain will find them of particular value; for example, the series of superb photographs of glaciated areas in the Rockies. Indeed the whole series of detailed examples, well illustrated by map and photograph, will give plenty of excellent material for teachers who can adapt it to various levels throughout the secondary school. Examples vary from a town study of Shanghai to a map of a Swiss farm before and after consolidation and to the power production of the Tennessee River; and the list could be lengthened almost indefinitely over a wide range of geographical elements. Perhaps one may mention particularly the excellent chapter on soils which is as good a summary as can be found in contemporary literature. In brief, this is an excellently produced book which will be invaluable in sixth form and universities.

R. C. HONEYBONE

BRITAIN'S NATURE RESERVES. By E. M. NICHOLSON. *London: Country Life*, 1957. 8¾×5½ *inches;* 175 *pages; map, plates.* 30*s*

The creation of the Nature Conservancy under the auspices of the Privy Council in March 1949, was the final stage of a movement, which began towards the end of last century, to protect certain areas of the country against human interference. By that time the National Trust, the Royal Society for the Protection of Birds, and various local organizations had begun to take steps to protect areas of special natural interest. Other societies followed, especially the Society for the Promotion of Nature Reserves which took the most active part in the movement after 1914 and together with The Royal Society's proposals for a Biological Service resulted in the formation of a central coordinating department.

This account of the present position of Nature Reserves in Britain, by the Director-General of the Nature Conservancy, comprises an authoritative summary of the locality, area, special points of interest and accessibility of each of the fifty odd National Nature Reserves scattered throughout the country. It is necessary to bear in mind that these are of very different types. They vary in size from the Cairngorms Reserve of some 40,000 acres to the Farne Islands, of only about 80 acres, and include a very wide variety of countryside in which nature can be preserved as a national heritage. Some are used for experiments on how native trees grow and their effects on the soil, or to study the effects of burning, or heavy rainfall, or grazing. Others serve to save rare animals and plants in danger of extinction, or to preserve outstanding features such as old pine forests or yew groves, and some reserves, such as Cader Idris, are of special interest for the study of geological features.

In addition to the Nature Reserves which are managed by the Nature Conservancy, there are others such as those managed by County Councils under the 1949 National Parks and Access to the Countryside Act, and those managed without statutory powers by the Royal Society for the Protection of Birds, and local Trusts such as the Norfolk and Lincolnshire Naturalists' Trusts. Also there are sanctuaries set up for birds under the third clause of the Protection of Birds Act 1954. The book concludes with an abridged bibliography of the subject and the addresses of reserve managements. It can be thoroughly recommended to all those interested in our native animals and plants and the landscape of the Nature Reserves of Great Britain.

EDWARD HINDLE

THE PURSUIT OF MOTHS AND BUTTERFLIES: an anthology. By PATRICK MATTHEWS. *London: Chatto and Windus*, 1957. 10×7½ *inches;* 141 *pages;* 67 *photographs including* 11 *in colour.* 30*s*

This is a charming and unusual compilation which can be thoroughly recommended to those looking for a suitable present for anyone interested in nature. The author has assembled thirty-one examples of descriptive writing which conjure up some of the feelings of a collector on a field expedition. Compton Mackenzie and Moray McLaren discuss butterflies and brown trout; Virginia Woolf, the convolvulus moth; William Beebe, the bay of butterflies; Wilfred Norris, dawn adventure; J. H. Fabre, the night of the great peacock-moth; and Alfred R. Wallace, the Aru Islands, Macassar and Batchian, to mention only a few of the extracts. As might be expected many Fellows of the R.G.S. are among the writers and the book helps to convey to armchair travellers some of the pleasures and hardships of collecting in most parts of the world. The inside covers include an outline map giving the location of the illustrations which range from Ruwenzori to the Arctic Circle and Japan to South America. The monochrome plates are excellent, but only one of the four coloured plates, that showing butterflies drinking, seems worthy of the additional expense of this form of reproduction.

EDWARD HINDLE

PROCEEDINGS OF SIXTH TECHNICAL MEETING OF THE INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE AND NATURAL RESOURCES: Edinburgh, 1956. *London: Society for the Promotion of Nature Reserves*, 1957. 9½×6¼ *inches;* 288 *pages; plates and figures.* 25*s*

The first conference in this country of the International Union for the Conservation of Nature was held in Edinburgh in 1956, with the Nature Conservancy and the Society for the Promotion of Nature Reserves as hosts. The Technical Meeting, the proceedings of which have now been published, was outstanding in respect of the number of different topics which were explored and the number and length of important papers submitted from many countries. The Editors were faced with a difficult task of selection and compression, but they have succeeded in presenting a balanced and reasonably full record of the papers and discussions in the four themes of management of nature reserves, consequences of myxomatosis, rehabilitation of

devastated areas, and landscape planning. There is much of interest to geographers, particularly in Themes III and IV; papers were contributed to the latter by Dr. Arthur Geddes, Mr. F. H. W. Green and Dr. Joy Tivy.

Reports and comments on this Sixth Technical Meeting and on the Fifth General Assembly held simultaneously with it are to be found in a previous issue of this *Journal*, **122**, 4 (1956) and in the *Scottish Geographical Magazine*, **72**, 2 (1956).

F. D. N. SPAVEN

HUMAN AND HISTORICAL

RENCONTRES DE LA GÉOGRAPHIE ET DE LA SOCIOLOGIE. By MAX. SORRE. *Paris: Marcel Rivière*, 1957. $7\frac{1}{2} \times 4\frac{1}{2}$ *inches; 215 pages. 570 fr*

Sociologists and human geographers share common subject matter—human societies—and study them by not wholly dissimilar techniques but from different points of view. Old rivalries between them have largely ended and a certain measure of mutual understanding and even of cooperation is now in evidence. In western Europe, at least, the human geographer's interest has turned to the regional study of the man/land relationship as it is revealed today and as this is explained in the light of historical processes. The sociologist's interest is no less directed to the present world and ranges from emerging modern societies to surviving complex societies of primitive culture. Sociology and human geography are clearly complementary not rival studies, for each is concerned with only one facet of mankind and each at times, in its search for truth, must invade the other's territory. While for the human geographer "environment" or "place" is of primary importance, for the sociologist this is secondary, his main concern being the societies themselves. Certainly each suffers from the great scale of its subject matter and the complexities which social conditions present or conceal. Their tasks—the accurate marshalling of the relevant facts and the interpretation of them—are clearly much harder than those of experimental scientists concerned with phenomena amenable to laboratory investigation and for the most part inert and strictly measurable.

In this book Professor Sorre brings his long experience as a writer on human geography to bear on some of the problems and concepts common to his subject and sociology. An introduction explains the nature of the two studies and succeeding chapters discuss "permanence and mobility," "space," "ecology," "some specific cases" and "geography and sociology before the technical revolution." Professor Sorre is at pains throughout the book to indicate where the two studies diverge or interlock and draws his illustrative material almost wholly from French and American practitioners. Electoral areas, religions and towns are selected in Chapter V as specific fields of study where human geography and sociology profitably cooperate. This book is objectively written and turns attention to an academic borderland where much is still little ploughed. It invites the reflection of those geographers who, like Professor Sorre, must consider in their work what sociologists are doing.

W. G. EAST

TYPES OF RURAL ECONOMY: Studies in world agriculture. By RENÉ DUMONT. *London: Methuen*, 1957. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 556 pages; diagram. 45s*

First published in Paris in 1954, this book has been translated by Mr. Douglas Magnin, of Erith Grammar School, to whom a word of special praise must be given for the vitality of the English text. The main difficulty of the reviewer was to put the book down: this time the "Punch" joke that reviewers keep fit by skipping had no point at all. The author has prejudices, strong views, the capacity to tilt at windmills, whatever one may call them: like a hunter pouncing on his prey, he swoops down on French agriculture at every conceivable opportunity. In fact he often swoops twice, once in the main body of the text and once—even more strongly—in a footnote. To some readers the book will prove quite maddening, even if they feel Dumont is very often right. But all must admit that he is fascinating.

The technique of the work is to illustrate world agricultural problems by the study of individual farms. Those who turn to the chapter on Britain may wonder why the text deals primarily with south Shropshire, but the reason is quite simple—the author was there for some weeks in the summer of 1950. Skilfully, the transition is made from two farms to others in the vicinity and then to British agriculture as a whole. His wide field experience is modestly indicated at the beginning of each chapter . . . "we have never been able to understand a system of agriculture without seeing it for ourselves." And nothing is taken for granted. Even so familiar an area as the Val d'Anniviers, written up by Brunhes and many later geographers, receives fresh and vigorous treatment in which large issues are raised. Should the Alps preserve the transhumant economy, or should the upper valleys be used solely as pasture and meadows, integrated into the farming of the whole of Switzerland, the whole of Austria? Is it wasteful of human effort to grow crops at such altitudes, on such steep slopes?

Chapters on Holland, Belgium, Spain, Italy, raise numerous questions of an economic and social character. Though the skill and hard work of the Belgian peasant must be admired, the combination of mining or factory work with farming makes life hard for those living on microscopic holdings. Much better, one might argue, to separate the two occupations and allow the farmers enough land to use modern machinery. Holland is regarded as having the "best type of intensive farming in the world," due largely to good agricultural education (at all ages) and the provision of capital . . ."only countries able to fulfil these requirements fairly quickly are going to win the war against hunger" (p. 434). But even in Holland it is useless to expect that the increasing population can be absorbed on the land, in spite of the reclamation of new polders. Under present conditions any country, however favourably circumstanced, may face a population problem, for the trend of the times is for the number of agricultural workers to decline. This, Dumont argues, is right for it removes unemployment and, still more, under-employment: it allows mechanization to take its right place on the farm: it frees land from supporting unnecessary draft animals or from growing crops to feed over-numerous households. The severity of the problem in southern Europe is vividly shown by the field studies, but the Swiss government is also called to task for its endeavours to maintain the *status quo* in the high Alpine valleys. Such government action, though admirably intentioned, may result only in propping up an economy that has no relevance now, whereas some radical change might produce better results for the local community, for the nation and for the world.

It would be unfair to reveal all the author's conclusions, or to deter any potential reader of this book. Suffice it to say that there are chapters on countries beyond the Iron Curtain, on parts of Africa and Asia with some references—in the reviewer's opinion too favourable—to North America. The maps serve only to show the location of the areas discussed, and attention should perhaps be drawn to the inaccurate statistics on p. 237 where the area of Ferrara province has apparently been multiplied by 1000. But these are details. What matters is that Dumont makes the reader think along two main lines—first, how is each farm to be welded into the food-producing economy on which all must depend and second, assuming that there is an optimum density of population on the land, how is it to be achieved? One can only hope—and this the author would wish—that this book may inspire more people to go and study farms as living entities: at least it will give such students some ideas on method.

T. W. FREEMAN

GÉOGRAPHIE DE LA POPULATION. Tome 1. By JACQUELINE BEAUJEU-GARNIER. *Paris: Librarie de Médicis*, 1956. 10×6½ *inches; 435 pages; plates, maps, tables, graphs and diagrams*

Although some American geographers deny that geomorphology is a part of geography, no geographer maintains that human geography is not vital to our subject.

It is, therefore, surprising that geographers have done so little work on population, the most human of human geography. Mme. Beaujeu-Garnier has for long been known as an eminent geomorphologist and this study puts her into that very select group of geographers distinguished in both the physical and human fields.

The geography of population is defined (pp. 13–14) as the study of the distribution, evolution and character of population, together with the causes and consequences of these aspects. There follow two general chapters, one on the reliability of very diverse statistical materials and the problems of their interpretation and mapping, and the other on general aspects of world population including references to population quotients and economic indices. This first part (49 pages) thus covers somewhat the same field as Pierre George, 'Introduction à l'étude géographique de la population du monde,' 1951.

Mme. Beaujeu-Garnier's distinctive contribution is, however, her regional treatment, and in the rest of this first volume she analyses the geography of the population of Western and Southern Europe and its projection by emigration to the U.S.A., Canada, Australia, New Zealand and Latin America. There are general, comparative and national sections, and so there are many viewpoints. Some of her material might well be found in the work of pure demographers, *e.g.* the evolution of European death and birth rates, age, sex and occupational composition, birth control and the "baby-boom" in the U.S.A., and this suggests that geographers could confine themselves to the undeniably geographical aspects of distribution and pattern which are also treated here.

Covering such a great field the book has laudably few errors, although the reviewer was disturbed to see (pp. 165–6) his town of Letchworth (the world's first garden city) described as a trading-estate city, whilst Slough is excluded from such a description. On page 165 the letters U.T.H.W.A.T.T. might make one conclude that a new organization of the United Nations was active here. But these and a few more errors are the merest trifles. Rather more serious, perhaps, is the fact that the dot maps of Europe, North and South America are insufficiently detailed because one dot is used for as many as 50,000 inhabitants.

There is a vast number of references to publications in many languages, a feature not invariably true of French works. The text is supplemented by fifty-four maps or diagrams and twenty-seven usually appropriate photographs. These are well produced, especially by French standards, though one side of each sheet is wasted. The rest of the production is also a credit to the publishers, though non-Latin peoples will truly rejoice when French books have their pages cut. Again, as is common in French books, there is no index, though one is intended at the end of the final volume to be published in May. This study ranks as one of our most important texts in any language, and is both a pioneer and a definitive work. R. J. HARRISON CHURCH

WORLD POLITICAL GEOGRAPHY. By G. ETSEL PEARCY AND ASSOCIATES. 2nd edition. *London: Constable*, 1957. 10×7 *inches;* xviii+734 *pages; maps.* 54*s*

This book of over 700 pages illustrated by over 100 maps, offers a survey of political geography that the Editors hope will enable readers to understand a constantly changing world. There are five general chapters which deal with the various aspects of political geography but which do not carry the study into new fields or throw fresh light onto existing fields. Indeed this is the general impression created by the whole volume. The thirty-one chapters that endeavour to cover the world, contain very useful and up-to-date summaries of the geographical and historical background of various countries rather in the style of Isaiah Bowman but frequently without his penetrating analyses. For example, the chapter on Switzerland provides the background that is necessary for a proper understanding of that country's geographical development but does not appear sufficiently to stress Switzerland's international position and influence. There is very little either in the matter or the arrangement that will be new to most students of geography. There is no doubt, however, that

this volume provides a most useful reference book, although it does not stand comparison with the detailed surveys in East and Moodie's 'Changing World.' Some of the maps too are open to criticism in that they do not add very much to the text. A case in point is the map of Africa on page 425 which reproduces features shown on any atlas without indicating the plateau character of the continent.

R. C. HONEYBONE

HANDBUCH DER NATURRÄUMLICHEN GLIEDERUNG DEUTSCHLANDS. Edited by E. MEYNEN and J. SCHMITHÜSEN. 4. und 5. Lieferung. *Remagen: Selbstverlag der Bundesanstalt für Landeskunde*, 1957. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 351/608 *pages*

REGIONALE STRUKTURE UND WIRTSCHAFTSFORSCHUNG-AUFGABEN UND METHODEN. By O. BOUSTEDT and H. RANZ. *Veröffentlichungen der Akademie für Raumforschung und Landesplanung: Abhandlungen, Band* 33. *Bremen-Horn: Walter Dorn*, 1957. 10×7 *inches;* 218 *pages*

GENERALVERKEHRSPLAN OSNABRÜCK. Teil I. Textband, Teil II. Bildband. J. SCHLUMS. *Akademie für Raumforschung u. Landesplanung. Veröffentlichungen-Reihe Gutachten*, Nr. 3. *Bremen-Horn: Walter Dorn*, 1956. $11\frac{1}{2} \times 8\frac{1}{2}$ *inches;* 152 *and* 249 *pages; maps, tables*

DIE MITTELALTERLICHE KULTURLANDSCHAFT DES GEBIETES UM GIFHORN. By G. OBERBECK. *Veröffentlichungen des niedersächsischen Amtes für Landesplanung und Statistik. Reihe A. Forschung zur Landes und Volkskunde. Bremen-Horn: Walter Dorn*, 1957. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 175 *pages*

These volumes display advantageously some interesting tendencies of German geography. The handbook and the volume on methods of research in regional structure and economy are concerned to provide a reliable framework for studies and for practical planning. The two parts of the handbook continue to give short and terse accounts of the many subdivisions of Germany and here deal with the Middle Rhine and the highlands to both sides of it, together with Hesse and the Harz. The contributors include older and younger German regional authorities. In these two parts there is possibly a greater attention given to settlement than in the earlier ones. An interesting discovery is that not all the contributors are pleased with the names and boundaries used in the original scheme of regional division, for a regional division cannot stand for ever, but must develop as our point of view changes. The volume of Boustedt and Ranz is an excellently documented discussion—none too optimistic in its conclusions—of the use of analytical methods and statistics to characterize the economic and social structure of an area and to delimit such areas. Many difficulties arise because statistics are deficient or apply to the wrong types of units, but basically because of the essential complexity of the human and natural situation. Political and administrative boundaries are in many ways more important than those we feel to be inherent in the natural scene. This subject tends to have a very ugly and unhelpful terminology. The bibliography is excellent.

The other two volumes are exercises in practical and historical micro-analysis, in which there is a tendency to overstate the detail and to rely too little on the summary statement of map and diagram. Professor Schlums' masterly analysis of the traffic problem of Osnabrück, an industrial town, with an old centre, may be of interest to those who study the traffic problems of Oxford or Chester. In the volume of maps, the latest, and even some novel, cartographical devices are used. Oberbeck's volume on Gifhorn, an area in the south of the Lüneburg Heath, astride the Aller, reveals the great wealth of the remaining German archives and their availability. The critique of place-name evidence is useful, but German settlement geographers rely on a stratification of names that, in detail, may prove mythical. On the other hand the discussion of deserted settlements is excellent, and would help a beginner in this study, for the author has located forty-seven of fifty-four such settlements on the ground and analyses well ridge-and-furrow long covered by forest. Historical geography of this

type, as the author shows, must be walked out on the land, for archives are not sufficient. The shapes of settlements are well assessed and well mapped. This area is also interesting as being on the immediate western border of early medieval Slav settlement, where, in fact, some Slavs seem to have lived. The author finds it quite useful to employ the natural units used in the official scheme reviewed above. The volume is rather long, while there is too little reliance on its excellent maps.

D. J. DAVIS

THE TRAVELS OF LEO OF ROZMITAL. Translated and edited by MALCOLM LETTS. Works issued by the Hakluyt Society, 2nd ser. No. CVIII. *London: Cambridge University Press for the Hakluyt Society*, 1957. 9×5½ *inches;* 196 *pages; maps and plates*

Baron Leo of Rozmital, we are informed, set out from Prague in 1465 on a long journey to the principal courts of western Europe, probably in order to obtain support for his brother-in-law, George Poděbrad, the Hussite king of Bohemia. Fortunately, two members of his retinue wrote accounts of his remarkable journey, which have survived, and which the late Malcolm Letts translated and edited.

The main interest of the chronicles lies in their account of court life and travelling conditions in the fifteenth century. Successively, Leo and his companions saw the noble and beautiful nuns of Neuss at their dancing, dined riotously at the court of Philip the Good, more sedately with our own Edward IV. The travellers re-embarked at Poole for France, and passed into Spain, of which the chronicles give an appalling picture. There were rival kings, rebellious subjects, a cathedral under siege, and brigands everywhere. Sea-robbers made off with one of the band, and the remainder of the party barely escaped with their lives. The return journey was made by one of the great routes of medieval Europe, from Provence over the Mont Genèvre pass to Milan and Venice, then to Villach, Graz and over the Semmering to Wiener Neustadt.

The historical geographer will find many incidental references of interest. On their journey through southern England, the travellers missed not only the "black fir-trees" of central Europe, but also the open fields; they observed that "the peasants dig ditches round their fields and meadows and so fence them in that no one can pass on foot or on horseback except by the main roads." Above all, Mr. Lett's skill in combining and editing the two chronicles has produced a surprisingly human story; the writers are not ashamed to admit drinking a little too deeply on occasions, or admiring the "women and maidens of outstanding beauty" which England was said to breed.

T. H. ELKINS

CARTOGRAPHY

AN INTRODUCTION TO MAPWORK AND PRACTICAL GEOGRAPHY. By JOHN BYGOTT. Sixth edition. *London: University Tutorial Press*, 1957. 8×6½ *inches;* viii+259 *pages; maps, diagrams, plates.* 16*s*

MAPPING THE WORLD. By ERWIN RAISZ. *London: Abelard-Schuman*, 1956. 9×6½ *inches;* 112 *pages; illustrations.* 12*s* 6*d*

An exciting, enthusiastic introduction to the vast scope of mapping the world, leading on to the more tedious task of driving home the fundamentals of map reading and map construction required for examinations, is probably the aim of many geography teachers. How rarely in fact do the textbooks meet this need. Bygott's book, widely used in schools and universities for the last quarter of a century, will probably continue to help young people pass examinations but is more likely to frustrate the imaginative nascent map-lover than to encourage him to widen his experience of maps. The text is coldly efficient, limited in its allusion, and, partly due to its age and patchy revision, strangely removed from present-day trends in maps and survey. A comparison with, for example, the Third Edition (1947) reveals little significant re-writing. Much of the discussion of Ordnance Survey maps remains the same

except for the change of a few verb tenses, with the result that some comments which had force in the 1930s are now open to a different interpretation. The One-Inch Tourist maps are a shadow of what they were, whilst the Half-Inch, apart from a single essay, has been dormant for many years. The $2\frac{1}{2}$-Inch map may be new in relation to the Ordnance Survey's span, but to many young users in much of our country it represents near antiquity. Timelessness both in map or related text is a dangerous aim; both authors and mapmakers would benefit their users by being somewhat more explicit about the dating of their works.

Raisz's book has a different aim, to excite. To quote its dust cover, "All the famous names are here with their work defined in glowing dramatic terms." Although its British readers might not be able to pass the usual examinations on its strength it nevertheless gives a very graphic account of the development of map making from its earliest rudiments to the present age of electronic devices and aerial photogrammetry. The young reader of this book is likely to cease wanting to be an engine driver and to demand a theodolite or trimet camera for Christmas. What is probably more significant, he may pass on to 'General Cartography' with aroused interest.

IAN MUMFORD

RELIEF FORM ATLAS: English edition. Edited by A. CHOLLEY. *Paris: Institut Géographique Nationale*, 1956. 13×11 *inches; 179 pages; photographic plates, maps*

This atlas is based on a selection of air photographs of France and French territories overseas, most of them taken in the normal programmes of photography for mapping under the auspices of the Institut Géographique National. The photographs are presented with contour maps of the same areas; some of the maps have been specially prepared for the purpose. In several cases anaglyphs have been used, that is, stereo-pairs of air photographs superimposed, one in red and the other in turquoise, so as to produce a three-dimensional effect when they are viewed through the spectacles provided. Some of the contour maps can be looked at in the same way; contoured models have been photographed from two positions, and the resulting superimposed patterns give a solid effect through the spectacles.

The atlas would be useful for helping students to appreciate relief from contour maps, but it does much more than this. The photographs are grouped to give examples of river patterns, cuestas, folded ranges, volcanic land forms, etc., from different parts of France, the North African deserts, and the humid tropics in West Africa, Indo-China and Madagascar, so that the atlas is a good source of information for sixth form and university students of geomorphology. As an example, folded ranges in a semi-arid climate are illustrated by an excellent photograph of a section of the Atlas ranges in Morocco, a contour map on a slightly smaller scale, and a simplified geological cross-section. An anaglyph of part of Madagascar shows a river-capture in operation; a pair of air photos of the Arve river, one taken in 1936 and the other in 1952, shows how the channels change; and three dimensional pictures and maps of the glaciers of the Mont Blanc massif cannot fail to impress. The descriptions alongside the maps and photographs are concise, but in places too brief, and the English is not always clear or grammatical. As an enthusiastic user of air photographs I find the Atlas very stimulating, and believe it will introduce many who study it carefully to a new world of interest.

On seeing the French production one is led to wonder if a British atlas of a similar kind should be attempted. Certainly the necessary photographs exist. Perhaps a more valuable contribution could be made by giving carefully worked out examples of the use of photographs for geological, soil and forestry surveys, and for mapping land use. The cost of such volumes as this is high, so is the price of individual air photographs. It would be useful for teaching purposes if standard sets of vertical air photographs of typical landscapes could be produced cheaply for classroom use by students, with key maps to indicate the information the photographs can provide.

A. T. GROVE

The publication of the QUAX-ATLAS FÜR LUFTFAHRER (*Frankfurt/Main: Quax*, 1957, DM75) causes one to reflect on the importance of private flying in Germany. At a time when the Federal authorities have just made a notable contribution to international aeronautical charting by publishing the eight sheets of the Luftfahrtkarte-Aeronautical Chart ICAO at 1 : 500,000 which cover the Federal Republic, a private concern apparently finds a market for the same type of information. It is difficult to justify this duplication of effort except on grounds of convenience of format and presentation. Whereas the ICAO documents consist of eight large map sheets plus Air Information Publications, Radio Facility Charts and NOTAMs, which the part-time flyer may find a cumbersome collection, the Quax-Atlas is a slim volume of small dimensions with the air information on the maps supplemented by data in the margins, and open to amendment from inexpensive monthly notifications from the publishers. One of the problems of the economics of aeronautical chart production arises from the susceptibility of the air information to frequent changes, which can most easily be made if all the air information is on one printing plate. This often results in a clutter of undifferentiated information when overprinted on a multi-coloured base map. To a certain extent the Quax-Atlas is easier to read than the ICAO charts in that the air information in two colours is overprinted on Ravenstein's 1 : 300,000 map which has a simple presentation of the basic topographic detail achieved notably by using hachures instead of layer colours. For local flying in Germany the Quax-Atlas will probably be quite adequate but is obviously no substitute for the ICAO documents produced for international traffic.

International cooperation in the production of atlases has been noticed before in these pages, and GOLDMANNS HANDATLAS, edited by Professor L. Visintin and Wilhelm Goldmann (*München: Wilhelm Goldmann Verlag*, 1957, *DM*74.70) is a striking example, which points once again to the economic advantages of such cooperation. For approximately £7 the German speaking public can acquire an attractively printed, up-to-date work which combines Italian art and German method. Its origins are of interest. Some years ago Professor Visintin cooperated in the production of the luxurious atlas privately published by the American Container Corporation. This compendium of geographical information was recast for the German market as Goldmanns Grosser Weltatlas by Goldmann and Visintin in 1955. Now the cartographic and statistical essence of that much larger and two-and-a-half times as expensive work has been revised and issued as the Handatlas.

The plates are well designed to give good coverage and the use of border breaks allows for the best page fit of awkwardly shaped territories. A pull-out fold enables the whole Mediterranean area to be extremely well displayed. The maps are generally layer coloured with relief detail expressed by a form of hachuring. Insets provide larger scale cover of important urban areas. There is a useful glossary of terms, much useful statistical information and a substantial index to names; but German policy with regard to place names subordinates or suppresses the current *de facto* national forms in former German areas and makes the atlas of less value to students of present-day geography, especially of eastern Europe. A startling omission is a key to conventional signs used on the maps.

IAN MUMFORD

BIOGRAPHY AND TRAVEL

FRA FRIBYTTER TIL EMBEDSMAND. By EJNAR MIKKELSEN. *Copenhagen: Gyldendal*, 1957. 9×6 *inches;* 198 *pages; plates. Kr.* 21.75

This is said by the publishers to be the fourth and last volume of Ejnar Mikkelsen's "reminiscences." But the book only takes us up to 1933. Is Mikkelsen really going to leave us in the dark about the most recent quarter-century of his still very active life? Those who have come to know and love his penetrating and lucid style will probably find more to enjoy in 'From freebooter to civil servant' than in most of his books. For the period covered, from 1912 to 1933, saw events which will still be fresh

in the minds of many of his contemporaries; such as the Danish-Norwegian dispute over the sovereignty of East Greenland. But time has dealt kindly with what must once have been bitter struggles, and today his views will do no more than stir a few poignant memories. Mikkelsen dances lightly over the years spent by him in overcoming Danish opposition to the colonization of Scoresby Sound. He remembers many details but he has not taken the trouble to check dates. Whilst never attempting to pass judgment on people, he does say who disagreed with him and why. Knud Rasmussen, Peter Freuchen, Lauge Koch, Ebbe Munck and a hundred others are there, sometimes engaged in political battles and at other times engaged, with Mikkelsen, in mutual back-patting. But nobody is dealt with unkindly. The story of East Greenland is interrupted here and there while we are taken whaling and cod-fishing; this only serves to add more high adventure to a remarkable collection of reminiscences. The book is bound to be used by some as a source of reference, and it is therefore a pity that there is no index. The section covering the Hague court dispute should not be taken as representing the considered views of any but Mikkelsen himself. Those who are unfamiliar with the story could give the other side a hearing by reading John Giaever's 'Den norske fangstvirksomheten på Østgrønland (Copenhagen, 1939), but those who really want the facts must find the book 'Legal status of eastern Greenland' (Permanent Court of International Justice, Series A/B, Fascicule No. 53, 1933). C. W. M. SWITHINBANK

THE GOLDEN EVENING: reflections of a country squire. By MICHAEL MASON. *London: Hodder and Stoughton*, 1957. 8½×5 *inches; 208 pages; plates.* 16*s*

The reviewer first encountered Mike Mason almost half a century ago in the boxing heats of a Thanet preparatory school. It was a momentary experience. Mason became a bit of a legend in his generation. At twenty-four he published a minor classic, 'The Arctic forest,' the fruit of several years spent as a miner and fur trapper in Alaska. In that book, he revealed talent as a naturalist and anthropologist, and like many Gaelic speakers, he showed an amazing gift for languages.

The Second World War caught him not too old to serve in the Royal Navy and to command landing craft in the Salerno and Normandy operations. Now nearing sixty, and in the enjoyment of broad acres in Oxfordshire and Scotland, the father of a young and numerous family, Mason reflects on the passage of the rural year in the literary *genre* of Gilbert White's 'Natural History of Selborne.' The book is replete with the lore and wisdom of the countryside and will be a delight to all country lovers. Mason is a keen and patient observer well served by ear and eye and he has many practical observations on forestry, wild bird conservation and stock-raising.

These notes are interspersed with recollections of war and travel. For instance, a discourse on red deer serves to introduce the habits of caribou and bison. A digression on stoats leads him to recall that some African tribes mix vein-blood with milk from their cattle. A kindly publisher might have suggested the use of the blue pencil here and there. No one would accuse Mike Mason of being a "blimp" but he has some violent dislikes, including all sorts of politicians, on whom he vents his inimitable gift for scathing metaphor. An experienced naturalist should recognize that these particular mammals are the victims of an environment producing deterioration. In discussing the comparable case of show dogs (pp. 157 *et seq.*) Mason indeed recognizes the results of specialization for exhibition purposes "which makes some show-dogs so stupid that they don't even know their names." W. E. D. ALLEN

MOUNTAINEERING BOOKS

By a characteristically friendly gesture, the Swiss Foundation invited an Englishman to write its centenary tribute to the Alpine Club, and Arnold Lunn's A CENTURY OF MOUNTAINEERING (*Allen and Unwin*, 1957, 30*s*) shows how felicitous the choice of

author was. His book is a delight, fluent and civilized. Some brief sections, consisting of records rather than accounts of first ascents and new routes, could have been written by anyone, but in the main Mr. Lunn reaffirms his high quality as essayist, whether his subject be the growth of mountain appreciation, Alpine guides of the Golden Age—the book hangs upon the chronological sequence of Golden, Silver and Iron Ages—the *Grosse Politik* of "blackballing" in the Alpine Club, or the deeds of the rugged modernists. His reappraisals of former household gods like Whymper and Mummery, and studies of Freshfield and Conway, are particularly well done, balanced yet without pretence of detachment. Leslie Stephen, however, whose diversity of achievement and neo-Utilitarian philosophy are not easily narrowed to essentials, receives a rather unfriendly prod. That Mr. Lunn's heart lies with earlier, more elegantly educated generations than ours seems fairly clear, and he challenges the "Calvinistic plainness" of modern climbing literature in a vigorous essay (chapter 19) which will require a very good reply. Brilliant photographs and colour reproductions of famous paintings adorn the book.

In 1882, when the clack of piton hammers, wielded on the Aiguille du Géant by the Sella brothers, was inaugurating new methods, and perhaps a new mountain morality, British rock climbing was being born, brought to life by the early achievements of Haskett Smith, King and the Pilkingtons on Great End, Pillar and Scafell. How the sport developed, under the impulse of O. G. Jones and the Abrahams in Lakeland in the '90's and of Archer Thomson in Wales at the century's turn, is told in a methodical, authoritative and very readable book by R. W. Clark and E. C. Pyatt, (MOUNTAINEERING IN BRITAIN, *Phoenix House*, 1957, 45*s*), which immediately proclaims itself as the standard work on its subject.

Reviewing the Swiss Foundation's annual, THE MOUNTAIN WORLD (*Allen and Unwin*), is like cramming the Crown jewels into a hatbox. What does one leave out? In the instance of the 1956/7 volume, the problem is a little easier for while some things sparkle brightly, and most shine with solid worth, a few are almost dull. One does not feel it is the translator's fault. Now 'The mountain world' is a record, and in parts designedly technical, but it must not become careless of its reputation as good literature. For then it may become a reference book, and be consulted merely, rather than read. The editor may have had thoughts of this kind himself, since he includes the first of a series of essays, in the spirit of anthology, and Ruedi Schatz's "Torre Venezia" is excellent writing. But there is also some perfunctory stuff in this issue, such as von Gunten's "Glacier Nord du Plan," Jayal's "Kamet," and Robert Forbes' wordy and uninstructive "Expeditionary Mountaineering." Fortunately, Editor Gurttner's own "Glacier Ice," Arnold Heim's "Virunga Volcanoes," and Himalayan essays by Band and Viallatte, more than retrieve the position. The photography throughout maintains the usual astonishing standard, notably in the Mackinley portfolio. The referencing is highly unsatisfactory for a book intended for serious readers, and typographical errors are not rare.

A greater tolerance for unvarnished information apart, the Austrian Alpine Club's JAHRBUCH for 1956 is not unlike 'The mountain world' in objectives and arrangement, and includes reports on no less than four Himalayan expeditions of 1955; Martin Meier, who climbed the north face of the Jorasses over twenty years ago, writes the least terse of these on the German-Swiss Dhaulagiri expedition, but all four suffer from a complete absence of maps; there ought to be a law about this sort of thing. Turning to the Cordillera Blanca, one finds that Hans Huber is also allergic to maps, but his writing is considerable compensation for this. Unlike the others, he admits that there is still joy as well as dedication in mountaineering although the Andes may only escape the graver traditions of Himalayan campaigns because they are in reality big Alps rather than little Himalayas. It is to be hoped that British climbers will not overlook the opportunities Huber describes by an exclusive preoccupation with the roof of the world. They must hurry; there is already a Nevado Munich.

To judge from SNOWDON BIOGRAPHY by G. W. Young, C. Sutton and W. Noyce (*Dent*, 1957, 25*s*), an absorbing survey of rock climbing in north Wales from "Genesis to Numbers," the process by which Snowdonia has been transformed over the years from a climber's nursery into a gymnasium has also produced a school of British climbers of unprecedented brilliance. Geoffrey Sutton is not alone in thinking the best of them without superior anywhere, though more singular in claiming that a process of natural selection is already operative, reserving the super-climbs to men of ascertainable physical type. Would Armand Charlet, who could not raise himself on his arms, really fail on Clogwyn? The views of G. W. Young, who contributes a historical retrospect with his customary grace, would be instructive on this point. Neither Sutton in the middle portion, nor Wilfrid Noyce in the concluding part of the book, considers the consequences of the exhaustion of Welsh climbing problems yet it is clear that the best men will not be content to repeat familiar climbs *ad infinitum*. The rank and file of good climbers will follow the best men where they can, but the best men must move on. Guide books in English for the guideless climber in the Alps are certainly overdue, but even this development seems unlikely if Sutton's dictum be true, that the climber is usually too young to write the guide, and the writer too old to do the climb.

In 1955, Eric Shipton found the body of Maurice Wilson, a Bradford man, at 21,000 feet on the East Rongbuk glacier. How it got there is told in Dennis Roberts' I'LL CLIMB MOUNT EVEREST ALONE (*Hale*, 1957, 15*s*). Cured of a serious illness by a faith healer, Wilson wished to show the world that faith could climb mountains; his plan was to parachute on to the flank of Everest, and climb to the top. He learned to fly, but learned nothing about mountains. After an epic flight to India, he had to sell his plane; he marched through Sikkim to die of exposure where Shipton found him. Wilson's sincerity and his determination are not in question, but what of his motives and methods? Mr. Roberts suggests that only a man of less faith would have taken greater precautions, an observation which invites the rejoinder that a purer faith might have implied even fewer precautions than Wilson actually took. The errors in chapter 3, regarding the history of Everest, could have been avoided by using, say, Professor Mason's 'Abode of snow.'

A. B. CUNNINGHAM

"The first ascent of Mont Blanc by Dr. Michel-Gabriel Paccard with a single porter in 1786 was the most important event in the history of mountaineering." So the authors of THE FIRST ASCENT OF MONT BLANC (*O.U.P.*, 1957, 70*s*) begin. T. Graham Brown and Sir Gavin de Beer proceed to justify their claim. Part of it scarcely needs justifying, being accepted history. But the name of Paccard has been so overshadowed by those of Balmat and de Saussure (who made the third ascent) that few of us are prepared to give credit to the humble local doctor who stood first upon the summit.

The book contains 450 pages of exact scholarship. But it is also a detective story, and an absorbing one. Clue by clue and letter by letter the authors unravel the threads, both of the early ascents and of the dismal way in which Paccard, who had climbed mainly to vindicate "his mountain" and left no written record of his ascent, was slighted and thrust into obscurity by jealous men. Bourrit I can cheerfully hand over to the lash; but nobody who has read 'Voyages dans les Alpes' will want to see feet of clay on de Saussure, who first offered a prize for the achievement. True, weakness rather than malice is attributed to him; but the charge is serious, and substantiated with formidable weight of evidence. He, the renowned scientist, rebuffed the little doctor and allowed himself to steal an undeserved immortality.

If there is a criticism, it is that the book is too long and costly for the private pocket. A cheap edition, cutting out Part II and the Appendices, perhaps also some pictures, would distribute more widely a book that should be read by any who want to appreciate the first milestone in mountaineering, and a remarkable man.

The pioneers would have been astonished to see their mountain now; to see girls of seventeen sunbathing on that sacred summit where Paccard and de Saussure

gasped: to see the criss-cross of routes that scours the face of every buttress and glacier. SELECTED CLIMBS IN THE RANGE OF MONT BLANC (*Allen and Unwin*, 1957, 18*s*) is a book for which British mountaineers have waited long. Not since last century has there been published in this country a guide to the routes of the Alps; and E. A. Wrangham, editor of this Alpine Climbing Group production, wisely starts with the district which is now, once again, the Alpine Mecca: the range of Mont Blanc.

There is an introduction, containing information about accommodation, equipment, and the systems of grading. Then the body of the book, which consists of translations by members of the Group from the various Vallot guides. The huts are given first, then 115 selected climbs from the different massifs, illustrated by the very effective French diagrams. The book is small enough for a rucksack pocket and easy to handle: important points. It deserves a success which will encourage the next volume, on the Valais, now in preparation. WILFRID NOYCE

INSTITUTE OF BRITISH GEOGRAPHERS: Transactions and Papers, 1957. Publication No. 23. Edited by R. W. Steel. *London: George Philip*, 1957. 10×7 *inches; 265 pages; maps and diagrams.* 40*s*

The 1957 Publication contains the Presidential Address to the Institute delivered by Professor L. Dudley Stamp entitled "Geographical agenda" and thirteen other papers. The most remarkable feature of the volume is its well balanced contents; seven of the papers are based on studies in the British area, while six of them are concerned with territories overseas. Similarly it was planned to include two papers on physical geography (one was, in fact, withheld as it had appeared elsewhere rather sooner than was expected), four on economic geography, three on historical geography, three on urban geography and two on general human geography. A more positive indication of the catholicity of interest shown by members of the Institute could hardly be desired. Another commendable feature under the same general heading is the uniform length of the published papers and the very fair distribution of maps and diagrams among them. It should be stressed that in every case the maps are well drawn and excellently reproduced; there are no instances of the over-reduction of the originals so that the printed map is unreadable.

Because of the variety of material covered it would be invidious to single out any special contribution. Special attention, however, should be directed towards the President's remarks, for his paper is most stimulating. Its sub-title gives an idea of its content—"A review of some tasks awaiting geographical attention." Professor Stamp's main concern is with the furtherance of our map techniques as geographers and with the greater need for concerted team work and collaboration.

The single paper on physical geography, by Dr. C. Embleton, deals with Wales—north-east Wales in particular—and it is curious that if the projected paper by Dr. Eric Brown had been published that, too, would have dealt with the physical geography of Wales; a special study of the 600-foot platform. The four papers on economic geography also present a wide range of interest. E. S. Simpson of the University of Liverpool writes on the Cheshire grass-dairying region, while W. H. K. Turner of Queen's College, Dundee, gives a fascinating account of the textile industry of Perth and district. The remaining papers on economic geography deal with heavy industry—T. S. Chandler pays special attention to the development of communications in his study of the Leicestershire and south Derbyshire coalfield, while J. E. Martin of the London School of Economics and Political Science takes us over to the Continent for an excellent study of the locational factors in the Lorraine iron and steel industry. The three studies in historical geography range from the Middle Ages to modern times. Dr. June Sheppard of Queen Mary College, University of London, describes and maps the Medieval Meres of Holderness, while Dr. S. R. Eyre of the University of Leeds discusses the upward limit of enclosure on the East Moor of north Derbyshire. Then follows a continental study by Dr. H. Thorpe of the University of Birmingham in which he discusses a very interesting special case of

heath reclamation in the Alheden district of Jutland, 1700–1955. The three urban studies are widely scattered in their location. Dr. Odell discusses the hinterland of Melton Mowbray and Coalville in Britain, while Dr. W. B. Morgan of University College, Ibadan, deals with the "grassland towns" of the Eastern Region of Nigeria, and Dr. Monica Cole presents a detailed analysis of the Witwatersrand conurbation. The remaining two papers fall into a category that can best be described as general human geography. One paper by Dr. H. C. Brookfield deals with some geographical implication of the *Apartheid* and Partnership Policies in Southern Africa while the other by Dr. A. T. A. Learmouth of the University of Liverpool discusses some contrasts in the regional geography of malaria in India and Pakistan. This paper is well illustrated by maps and a series of attractive line drawings. E. G. BOWEN

SHORTER NOTICES

The African explorers of old tried to come up the great rivers to the interior, and were constantly thwarted by impassable waterfalls; James Meester and John Waller tried to go down an African river, and were equally thwarted by a waterfall which was not marked on the map. AND THE RIVER FLOWED ON (*Odhams*, 1958, 18*s*) is a light-hearted account of a hazardous holiday trip 550 miles down the river Tana to the Indian Ocean, by two members of the Kenya Police Force. James Meester writes the lively narrative and his story is excellently illustrated by John Waller's photographs.

J. B. Carson's SUN, SAND AND SAFARI (*Robert Hale*, 1958, 18*s*) is a pleasant and unpretentious account of a District Officer's twenty years in Kenya. His experiences of places as far apart as the island of Lamu and Lake Victoria are reconstructed from notebooks kept up to 1952, and he throws in some history for good measure. Readers of the *Journal* may remember an interesting article on the Cherangani highway by J. B. Carson and M. A. Unwin-Heathcote which appeared in the issue for September 1951, together with a map; part of it is reproduced in Mr. Carson's book.

In MERMAID SINGING (*Michael Joseph*, 1958, 18*s*) Charmian Clift has written an interesting, and not quite ordinary, account of how she and her husband took their two children to live on the Aegean island of Kalymnos, away from the fog and fury of London life. Nearly all the able-bodied men on Kalymnos are sponge-fishers, and their hard and dangerous life is Mrs. Clift's recurrent theme. 'Mermaid singing' shows up with unusual clarity the contrast between the romantic affection of the visitor and the realistic disenchantment of the native for such outposts of an older way of life.

Two books on Norway will be welcome to the increasing number of holiday-makers who visit Scandinavia. SOUTH NORWAY (*Allen and Unwin*, 1958, 25*s*) was finished just before his death by the late Commander F. N. Stagg, and completes this attractive series on Norway. A good, plain end-paper map and excellent black-and-white photographs illustrate the usual workmanlike blend of history and geography. NORWAY INVITES (*Hutchinson*, 1958, 12*s* 6*d*) is by that energetic author of guide books, Monica Krippner, and its contents are more severely practical than its title suggests. As such, it is to be recommended, and it is in a handy pocket size with good print.

A. and C. Black's "Land and People" series has already thrown its net widely over Europe, Asia, Africa, the Americas and Australasia. The latest two, DENMARK, by Reginald Spink, and MALAYA AND SINGAPORE, by Joanna Moore, are a further proof of catholicity, and give good value at 7*s* 6*d* each. The series is designed for a young audience, but DENMARK would make a useful guidebook for any age. MALAYA AND SINGAPORE is concerned more with general information on the history and geography of these areas.

KNOWLEDGE OF LONDON (*Cousland*, 1958, 15*s* 6*d*) is a guide with a difference; intended for car-drivers, it gives directions for finding an enormous number of places without recourse to maps. The author, Colin J. Hunt, calls this the "conversational" method of direction, and limits his maps to very simplified outlines. The white-on-black design of these is somewhat dazzling at first sight, but they are very clear when the eye becomes used to them. DOROTHY MIDDLETON

"I will lay on for Tusculum, and thou lay on for Rome"—or so the authors of the "Beaux Pays" series might well be saying. Du Colombier is no exception. He lays on for SIENNA (*Nicholas Kaye*, 1957, 35*s*) with loving enthusiasm, but with scholarship enough not to lose his head or his way among such riches. The resulting picture recalls the narrative dexterity of the Siennese Masters which he so fully appreciates. G. A. LANGDON

THIS IS AUSTRALIA, edited and produced by Oswald L. Zeigler (*Oswald Zeigler Publications, Sydney*, 1958, 50*s*) is a large and, in the main, a well produced book narrating the story of Australia to 1956. This is not a scientific work but one of real topical interest and of the widest appeal. There are excellent pictures including a number in colour. At times the pages tend to be overcrowded.

There are 80 pages of photographs and 11 pages of text in Jaroslav Noyak-Niemela's AUSTRALIA: THE GREAT SOUTH LAND (*Angus and Robertson*, 1957, 12*s* 6*d*). This is an interesting and topical book in which most aspects of the varied scenery and the life of the peoples of Australia are dealt with. Its simplicity and excellence is marred by a number of photographs being reproduced in much too dark a tone.

Brazil is not a well known country and BRAZIL IN PICTURES which was first published in French in 1950 is a valuable contribution to the scenic and architectural knowledge of the country. There are 215 photographs on 128 pages all of which are clearly reproduced. The captions are of the briefest but the notes on the illustrations make this a most instructive book. The photographs are by A. Bon, M. Gautherot, and P Verger. The introduction is by Alceu Amorosa Lima, notes by Antoine Bon, translated by Laetitia Gifford. (*London: Gerald Duckworth*, 1958, 25*s*; *New York: Studio Publications Inc.*).

The recent history of Kenya is being told in a novel way, scarcely repeated elsewhere, by M. F. Hill whose 'Permanent Way, The story of the Kenya and Uganda Railway' appeared recently. Now we have PLANTERS' PROGRESS, The story of coffee in Kenya (*The Coffee Board of Kenya, Nairobi. No date.* 42*s*). This is a detailed account of the economics of coffee growing, the people concerned and the vicissitudes of new crop in a young country. The forty pages of photographs tell the story of coffee from blossom to roasting together with some about the country. P. J. T. BARBARY

THE SOCIETY'S NEWS

MEDALS AND AWARDS

Her Majesty The Queen has been pleased to approve the award of the Royal Medals as follows: *The Patron's Medal* to Dr. Paul A. Siple, United States Antarctic Expedition, scientific leader at the IGY South Pole Base (the "Amundsen-Scott" Base), 1957, for contributions to Antarctic exploration and research; and *The Founder's Medal* to Sir Edmund Hillary, K.B.E., leader, New Zealand component, Commonwealth Trans-Antarctic Expedition, for Antarctic and Himalayan exploration. The Council of the Royal Geographical Society has awarded a *Special Gold Medal* to Sir Vivian Fuchs, leader, Commonwealth Trans-Antarctic Expedition.

The Council also announces the following awards: *Victoria Medal* to Professor Roberto Almagià, Professor of Geography, University of Rome, for contributions to geographical research; the *Murchison Grant* to Professor E. G. Bowen, Gregynog Professor of Geography and Anthropology, University College of Wales, Aberystwyth, for studies in the geography of Wales; the *Back Grant* to Ingénieur-en-Chef Bertrand Imbert, leader of the IGY French Antarctic Expedition 1957–8, for contributions to Antarctic exploration and research; the *Cuthbert Peek Grant* to Dr. Peter H. Davis, Lecturer in Botany, University of Edinburgh, for botanical exploration in south-east Turkey; the *Gill Memorial* to Dr. M. J. Wise, Cassel Reader in Geography, London School of Economics, for studies in economic geography; the *Mrs. Patrick Ness Award* to Captain A. G. Bomford, R.E., for his contributions to the survey and mapping of South Georgia, as chief surveyor of the South Georgia Survey, 1955–6.

THE COMMONWEALTH TRANS-ANTARCTIC EXPEDITION

Sir Vivian Fuchs and his Trans-Antarctic party, leaving the South Pole on 24 January 1958, arrived at Scott Base, after a journey of 1250 miles, on February 27. They were met at Depot 700 by Sir Edmund Hillary, who had flown from Scott Base in a Beaver aircraft. He accompanied the party back to McMurdo Sound. On arrival there Dr. Fuchs heard that Her Majesty The Queen would confer a knighthood on him. The President and Council of the Society sent the following telegrams:

Fuchs, Scott Base, Wellington:

President and Council Royal Geographical Society on your completion of first overland crossing of Antarctic continent send their heartiest congratulations to you and crossing party as well as to all those from United Kingdom and New Zealand whose splendid efforts in Antarctica under your skilful and inspiring leadership have helped to bring to this successful conclusion a great Commonwealth exploring and scientific enterprise.

Hillary, Scott Base, Wellington:

President and Council Royal Geographical Society send heartiest congratulations to you and your men on the great contribution you have all made to the successful outcome of the Commonwealth Trans-Antarctic Expedition.

The following reply was received from Sir Vivian Fuchs:

All members of the Trans-Antarctic Expedition and I were most happy to receive your kind message of congratulations which gave us a great sense of satisfaction.

GRANTS TO EXPEDITIONS 1958

The Council has approved grants totalling £1125 (including £45 from the Stephens Bequest and £47 from the Penruddocke Bequest) to 12 expeditions in 1958, and 14 other expeditions have been approved; instruments have been lent to 13 out of this total of 26 expeditions. Details (to May 1958) are as follows:

Keystone Press Agency

Sir Vivian Fuchs during the Trans-Antarctic Expedition Press Conference at the Society, 2 May 1958. On left, Hannes La Grange, Expedition Meteorologist

Financial aid: Imperial College Iceland Expedition (£75 plus instruments); University College London Exploration Society to Iraqi Kurdistan (£75); Cambridge Spitsbergen Expedition (£75 plus instruments); Cambridge Underwater Expedition to Apollonia (£103 plus £47 Penruddocke Bequest plus instruments); Cambridge West Greenland Glaciological Expedition (£100 plus instruments); Naval Colleges' Iceland Expedition (£75); Birmingham and Exeter Universities' Spitsbergen Expedition (£75 plus instruments); Oxford University Tanganyika Expedition (£100 plus instruments); University of Durham Expedition to Svartisen (£50); Cambridge Expedition to Sierra Leone (£55 plus £45 Stephens Bequest); Mr. J. Ward Perkins' field studies of ancient and medieval geographical environment in Southern Etruria (£200); Makerere College, East Africa, glaciological expedition to Ruwenzori (£50).

Approval and instruments: Oxford Chitral Expedition; Cambridge Atacama Desert Expedition; British-Pakistani Forces Himalayan Expedition; Darwin Centenary Expedition to Chile; Minapin (Karakoram) Expedition; 1958 Sherborne Kulu-Spiti Expedition; Chamba-Lahul Expedition.

Approval only: Dr. D. S. Rice's Expedition to Harran, III; Oxford Snaefellsnes Expedition (West Iceland); Cambridge Pyrenean Expedition; Cambridge Annobon Island Expedition; Cambridge Vannöy Expedition (North Norway); Wye College Icelandic Expedition; Westminster Hospital Medical Students' scientific expedition to Belgian Congo.

In addition to the above, substantial grants in aid were made to expeditions in mountain regions by the Mount Everest Foundation, constituted by the Society and the Alpine Club; and a grant of £50 was awarded to the Cambridge Underwater Expedition to Apollonia, and £25 to the Oxford University Tanganyika Expedition, by the Geographical Magazine Trustees.

APPLICATIONS FOR GRANTS 1959

Applications for grants for both exploration and research for the year 1959 must reach the Director and Secretary not later than **16 February 1959** (note change of date); it is only in very exceptional circumstances that later applications can be considered. Applications must be **typed** on the Society's own form which can be obtained on request; they must be accompanied by evidence of support from institutions or qualified individuals supporting the proposed expedition or research. Leaders of expeditions and other applicants for grants may be expected to attend an interviewing board.

THE RECORD

CONTRIBUTORS TO THIS ISSUE OF THE *JOURNAL*

Phillip Law, Director of the Antarctic Division of the Australian Department of External Affairs, and leader of the Australian National Antarctic Research Expeditions (ANARE), has made fourteen voyages since 1947 to Antarctic and sub-Antarctic territory. *Dr. H. von Wissmann*, the distinguished Arabian traveller, is Professor of Geography in the University of Tübingen; *Professor R. B. Serjeant* is Professor of Modern Arabic in the University of London. *Professor E. W. Gilbert* is Professor of Geography in the University of Oxford. *Dr. Marjorie Sweeting*, University Lecturer in Geography at Oxford, received the Society's Gill Memorial in 1955. *Douglas Botting*, chairman of the Oxford University Exploration Club, was leader and director-cameraman of the Oxford University Expedition to Socotra in 1956. *C. Kidson* is Head of the Coastal Physiographic Section of the Nature Conservancy; *A. P. Carr* is on the staff of the Section; *D. B. Smith* is on the staff of the Isotope Division of the Atomic Energy Research Establishment, Harwell. *G. A. Worrall* is a senior lecturer in pedology in the Faculty of Agriculture, University of Khartoum. *Professor C. A. Cotton*, awarded the Victoria Medal in 1951, is Emeritus Professor of Geology, Victoria University College, New Zealand.

A MAP OF MOUNT EVEREST, 1 : 25,000

With the 'Jahrbuch' of the Österreichischer Alpenverein for 1957 is published a fine map of the Mount Everest region on the scale of 1 : 25,000. Though in the main depicting the southern approaches, it includes the upper portion of the Rongbuk glacier on the north. The map is based on a stereo photogrammetric survey carried out by the Alpine topographer Erwin Schneider on the International Himalayan Expedition of 1955, led by N. G. Dyhrenfurth, and is supplemented by the work of earlier expeditions. The stereo pairs of photographs were plotted at a scale of 1 : 10,000 on the stereo autograph machines of the Institut für Photogrammetrie, München, directed by Dr. Richard Finsterwalder, and the final map was prepared, with rock drawing, hill shading, etc., by the cartographer Fritz Ebster. Dr. Schneider describes in a short paper his work in the field, where the greatest obstacle encountered was the weather. A Zeiss II theodolite, reading to a second, and a Zeiss phototheodolite TAF were employed for the triangulation and the photogrammetric survey—thirty-one photogrammetric stations being occupied. Of the total area of the map, 81·3 per cent. rests on precise survey. All newly determined heights are based on the official height of Mount Everest, so that most of the Survey of India heights have been modified. The material used to supplement the 1955 survey included work by Colonel O. E. Wheeler, Michael Spender, and the Houston flight of 1933, with more recent work by the Indian Air Force and Charles Evans. The map is very detailed, down to paths and stone walls, and is drawn in the style of the Alpenverein's maps of the Alps, so that a direct comparison of this Himalayan area with the eastern Alps is possible. It is printed in six colours, line plates of black, blue and brown, and tone plates of buff and grey, with a green plate combining line and tone. The contour interval is 20 metres, with every 100 metres emphasized. Contours are maintained across the rock faces, in black, and across snow slopes and ice, in blue; elsewhere they are in brown. This unusual feature, with the aid of a close contour interval, allows the rock faces to be depicted with a simple line shading in black, thus reducing considerably the draughtsman's task. Areas other than rock face, snow or ice are buff tinted, and hill shading is in greyish brown, pale green or green-blue where appropriate. In addition to the effective rock work, moraines and screes, also in black, are shown in detail. Woods and scrub are in green with a fine blue symbol. The result is a very expressive representation of a complex topography. As regards nomenclature,

native names are stated to have been used as far as possible, transcribed according to the Survey of India system, and there are some differences from British usage. "Mount Everest," however, has been retained. Chomolongma is applied to the group, and Mahalangur Himal to the range. The term glacier is generally employed, in the absence of a native expression. The publication of the map has been assisted by the Deutscher Alpenverein and the Deutsche Forschungsgemeinschaft. G. R. CRONE

IGU NEWSLETTER

No. 1, Vol. 9, of the IGU *Newsletter* contains the First Circular of the XIXth International Congress, to be held at Stockholm in 1960. The hosts for the Congress will be the five northern countries, Denmark, Finland, Iceland, Norway and Sweden, whose National Committees are already busy with preparations. A representative executive committee has been appointed under the chairmanship of Professor Hans Wilson Ahlmann; for the present the committee's address is: The International Geographical Congress, Postfack, Stockholm, 6. The General Assembly of the IGU and the Congress meetings will take place in Stockholm from 6–12 August 1960; symposia and excursions will be held in the five countries before and after the Stockholm meetings.

The current *Newsletter* also contains a list of some publications of the XVIIIth Congress, in addition to those listed in the last number (Vol. 8, No. 2, 1957), and a report on two of the special commissions—on the humid tropics and on a world population map.

INTERNATIONAL GEOPHYSICAL YEAR: MOUNT KENYA

News has been received from Nairobi of the expedition which spent seven weeks of 1957/8 on Mount Kenya, led by Dr. Igor Loupekine. The expedition was carrying out research for the International Geophysical Year, and its study of the glaciers is regarded as one of the twelve major investigations of the IGY programme. Despite the initial effects of altitude sickness and the limitations on movement caused by lack of oxygen, the IGY members fulfilled an ambitious programme, set by the British National IGY Glaciological Committee. In addition to the glaciological research, carried out mainly on Lewis glacier, meteorological stations were set up at suitable points on the mountain, and investigations were made into the geology, hydrology and biology of the region.

THE GEOGRAPHICAL ASSOCIATION

The Annual Conference of the Geographical Association was held from 31 December to 3 January 1958 and all the lectures were well attended. A particularly large audience listened to Professor A. E. Smailes of Queen Mary College, London, speaking on "Urban studies" at a joint meeting with the Royal Geographical Society and the Institute of British Geographers, held at the Royal Geographical Society's House by kind invitation of the President and Council.

Professor Smailes paid tribute to some of the early workers in urban geography, notably Dickinson and Green. He mentioned the pioneer work that had been done on spheres of urban influence and also the many detailed studies of urban morphology. The latter, largely based on maps, had greatly added to our knowledge of towns but sometimes the use of a two-dimensional map failed to convey the true character of an urban area. It could easily ignore what Professor Smailes called the "texture of a town" by a failing to emphasize the three-dimensional aspect of buildings. With a wealth of illustrative matter and descriptive detail, he gave examples of various types of towns viewed in three dimensions and went on to an analysis of the main forms of urban growth in the last century. He distinguished for instance, with the aid of air photographs, the terrace ribbing pattern of much Victorian housing, the villa studding of more recent housing and finally the block clumping of flats in modern times. Professor P. W. Bryan took the chair, and Sir James Marshall-Cornwall welcomed a

large gathering to the Society's House and invited everyone to view the exhibition of the early growth of London then on view. Professor Smailes' lecture was the first one of a series of meetings on various aspects of urban geography. Mrs. D. Monteith's interesting account of the development of Saffron Walden showed how the main line railway had avoided the town, and that this had impeded its growth. Later in the week Mrs. Monteith took a party of members to Saffron Walden. Dr. A. Garnett contributed to the study of urban areas by analysing atmospheric pollution as a factor of urban geography, and Mr. G. F. A. Wilmot introduced a different facet by considering "the scope of railway geography in urban areas," and illustrating it by a coach tour to examine some aspects of railway development in North London. Professor E. W. Gilbert of Oxford contributed a fascinating analysis of the "Geography of seaside towns" and made a special plea for more research work on the medical geography of resorts, emphasizing the vagueness of such terms as "bracing" and "relaxing." He also urged geographers to give more weight to descriptive geography, to analyse the beauty of urban and rural scenery, and not to be afraid of expressing subjective feelings. Professor Beaver introduced yet another aspect by analysing the changing industrial landscape of Great Britain, stressing the great part played by modern technology in modifying the effects of industrialization. Professor Bryan in his presidential address on "Landscape and geography" impressed on his very large audience that geographers must primarily deal with the landscape as a whole, including the interrelated parts of the physical and the cultural. Although the main theme of the Conference this year was "Urban geography," yet the physical landscape did not escape attention for Mr. W. Vaughan Lewis of Cambridge gave a splendid scientific analysis of the recent work done on "Erosion by cirque and valley glaciers." Nor was the teaching side of geography forgotten. A very lively discussion on the effect of Ordinary Level examinations on the teaching of geography opened the conference, and on the last day of the lectures Miss P. M. Jeffery gave a lesson showing the follow-up of a field expedition in an urban area, and Mrs. I. L. M. Long presented the results of the research project into "the interpretation of geographical pictures by Secondary School children."

The last day of the Conference was devoted to a series of excursions which included, in addition to the two already mentioned, a tour of the sites of London's former airports, a tour of metropolitan Essex, a traverse by coach to Cambridge and a walking expedition to examine the site and function of the City of London.

R. C. HONEYBONE

SURVEY OF ISRAEL

Two papers have recently been sent to the Society's Library by Mr. B. Goussinsky, chief geodetic engineer and mathematician to the Survey of Israel. "On the classification of map projections" (reprinted from the *Empire Survey Review*, 11 (1951)) presents a formal, logical exercise in classification. The purpose of classification is to group the objects under consideration according to their affinities in order that the whole subject may be better appreciated. Mr. Goussinsky has achieved his purpose with regard to "regular" projections, but since the scheme does not apply (as he states) to conventional or non-regular projections its value is necessarily limited, but nevertheless provides a worth-while starting point for the study of map projections.

"A proposal for standardization of scales of maps in cartography" is a paper read at the Second Convention of Scientific Societies (Association for the Advancement of Science in Israel), held at Jerusalem in July 1957. Many advantages would result from a high degree of standardization regarding the scales of maps published throughout the world, and Mr. Goussinsky suggests a basis for such a scheme. His suggestion is to adopt the 1 : 1M scale, and thirty-seven derived from it, as those from which a selection would be made in each case. It is interesting to note that an agreement to standardize the scales of land maps for use by the armies of the United States, United Kingdom and Canada specifies seven scales, all of which are included in

Mr. Goussinsky's scheme. Agreement about scales to be adopted by various national survey departments might be rather more difficult to reach.

P. H. KENNEY and S. G. HUDSON

SOME NEW JAPANESE MAPS

In connection with the Regional Conference of the International Geographical Union in Japan, held from 28 August to 3 September 1957, two special exhibitions of maps were arranged. One was a quite astounding collection of historical maps, a large number in manuscript and mostly belonging to the remarkable library of Tenri University near Nara. This wealthy religious foundation has gathered together not only an outstanding series of the classical published maps but many others scarcely known to western scholars. Early Japanese cartographers devoted their attention mainly to their homeland and original exploration was almost restricted to the Kuriles and Sakhalin. Though it is believed Japanese navigators had reached and explored Australia long before Cook, the appearance of Australia on Japanese world maps clearly awaited European sources. A revolution in Japanese home cartography took place when Ino introduced triangulation surveys and from 1816–40 produced maps in great numbers which are both beautiful and accurate. For future reference a catalogue of the exhibition, showing the collections from which the maps were borrowed, is filed in the Society's Library.

The other exhibition was of modern maps, displayed in Tokyo, mainly of those produced by the official Geographical Survey Institute (Ministry of Construction) at Chita and whose Director, Dr. A. Watanabe, was one of the Secretaries of the Conference. The extensive range of topographical sheets is well known, but interest centres on the varied new maps, all produced since the Second World War and partly of an experimental nature. Some of these have been described (in English) in the *Bulletin* of the Institute (see especially T. Nakano, "The use of aerial photography in land form classification survey in Japan," *Bull. G.S.I.* **4** (2), 1955, 1–21) but have scarcely yet been seen by western geographers. It has long been the tradition to publish the legend of geological maps both in Japanese and English with international symbols but most other maps are in Japanese only. There are excellent general geological maps on different scales, but only recently was a start made on the detailed 1 : 50,000 scale. The reliance of Japan on fish as a main source of animal protein has led to some detailed surveys of surrounding waters, including bottom deposits of which detailed maps of certain areas and a generalized map of the whole of the seas round the Japanese islands have been published.

The ever-increasing pressure of population on land resources, with every acre of cultivated land required to produce food for six to seven people, has led to great attention being paid to existing land use and the reasons for that use. Japan adopted and then expanded for its own needs the scheme of land use classification laid down in 1950 by the Commission of the I.G.U. and advocated by the World Land Use Survey. The work of land use survey, based partly on field-work, partly on the interpretation of air photographs, has been pushed forward with great vigour. The maps printed are on the scale of 1 : 50,000 and are the most detailed, as well as the most beautifully produced of any country and show a mass of detail basic to both town and country planning. Three hundred sheets, covering about one-third of the whole country (with the exception of Hokkaido, which is separately dealt with) had been completed by mid-1957. As the work is financed mainly by prefectural governments, the mapping ceases at the borders of the prefectures concerned and unfortunately the maps are not on public sale. Anomalies in land use—for example the contrasted use of different parts of the slopes around basins, stand out clearly when the maps are carefully examined and point to areas needing detailed investigation. Too often land use in such cases is a reflection, not of physical factors, but of land ownership and individual enterprise. The other new maps are more frankly experimental. Some Japanese workers urge that land form classification and mapping are

basic to soil survey, geological survey and land classification survey. All these are being started on the 1 : 50,000 as the standard scale. The first and only sheet of the soil map on this scale (based on Series mapping and soil profiles) was published in 1953; geological mapping on this scale was started in 1951 and one sheet published. Special interest centres on the three experimental maps covering the Tomioka area (each 1 : 50,000). One is described as a "River system and valley density map." Over a grey background are printed in green all valleys shown by aerial photographs to be under degradation including gullies. Overprinted with a blue kilometre grid are the numbers of such valleys per Km.²—varying from 1 to 256. The "Distribution of slopes" map shows in full colours seven categories of slope, from less than 3° to over 40° the critical figures being 3°, 8°, 15°, 20°, 30° and 40°. The "Land form classification map" shows two distinct features. One, by black symbols, is texture of surface material—clay, silt, sand, gravel, rounded and angular stones of different size, loam. In colour sixteen types of land are distinguished and another thirteen geomorphological features (such as talus, landslide, cliff, knickpoint) and an inset map is given of land form divisions—which might be called minor physiographic regions. Finally two profiles showing land forms are added. Japanese geographers hope that this map in particular will be extended over large areas. Copies can be seen in the Society's map collection.

L. DUDLEY STAMP

A NOTE ON MOUNT OXFORD, NORTHERN ELLESMERE ISLAND

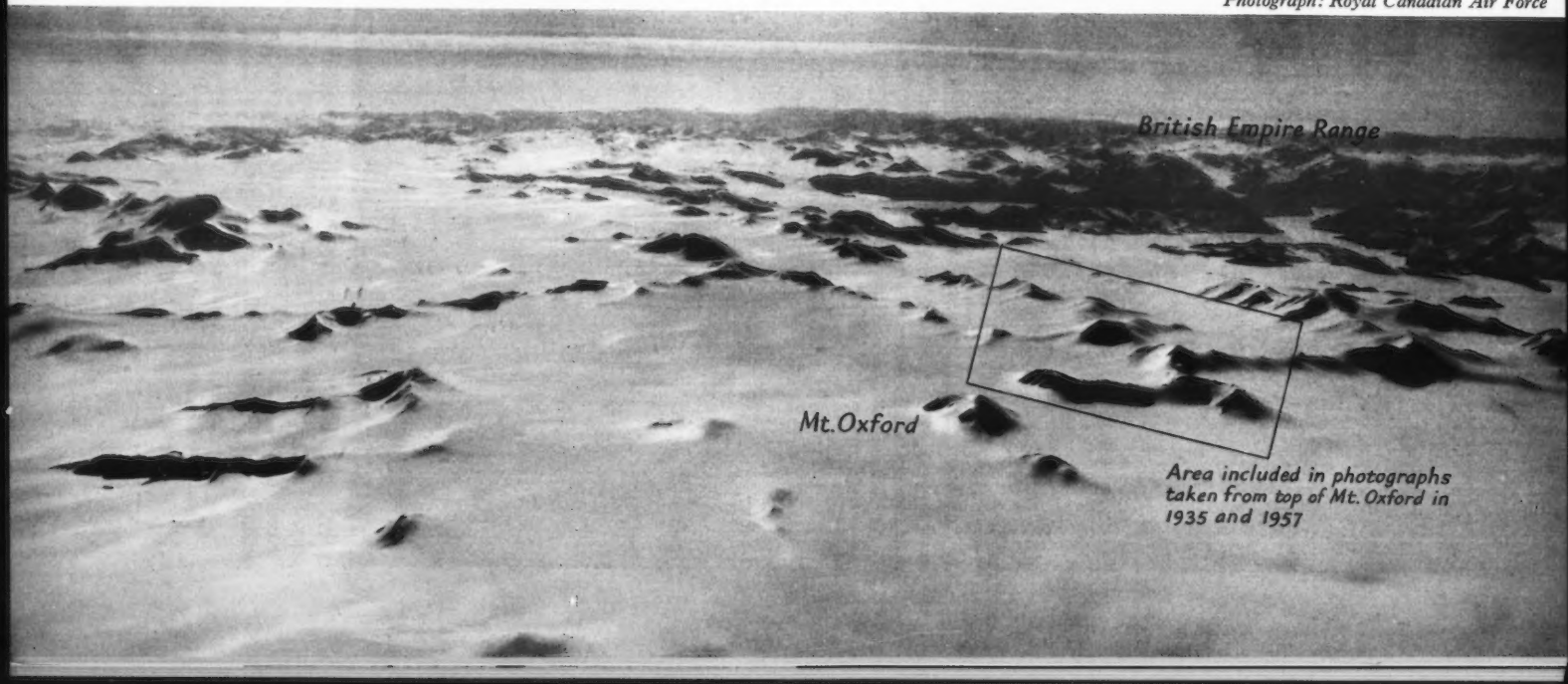
In 1935 two members of the Oxford University Ellesmere Land expedition with two Greenland Eskimos visited the Lake Hazen region of northern Ellesmere Island; they made the long journey by dog sledge from the expedition base at Etah in north Greenland.[1] Two members of the party, travelling via Gilman Glacier, made the first ascent to the ice cap which covers much of the mountainous region between Lake Hazen and the north coast. They were A. W. Moore, whose untimely death occurred in 1937,[2] and the great Eskimo traveller Nookapingwa, whose death in 1956 seems to have passed unrecorded. During their absence on the ice cap the other members of the party, Sergeant H. W. Stallworthy, R.C.M.P., now of Vancouver Island, and the Eskimo Inutuk, now living at Thule (Kanaq), maintained a fish camp on Lake Hazen. Moore and Nookapingwa reached Gilman Glacier via the winding and canyon-like valley of the river which drains it. This passage is described as "the worst going throughout the whole journey from Etah." Once the ice cap was reached they marked as their objective "a far-off isolated peak due north of us." They reached the summit of this peak, named on the return of the expedition Mount Oxford, on May 1 in three days from Lake Hazen. Moore estimated its height as 9000 feet; beyond to the north-west "stretched a great range of mountains, the summits of some of which must have reached a height of ten thousand feet or more." These mountains were later named British Empire Range. Moore records that "Nookapingwa pointed out . . . what he said was the sea-ice in [Clements] Markham Inlet on the north coast."

In late April and early May 1957 the Defence Research Board of Canada with the help of the Royal Canadian Air Force established an International Geophysical Year station on the north shore of Lake Hazen and a summer camp on Gilman Glacier at an altitude of about 3400 feet. During the course of field work Moore's route was traversed again after an interval of twenty-two years, and several interesting points arise from a comparison of Moore's account with recent observations. The passage between Gilman Glacier and the lake, in contrast to the earlier passage, presented no difficulty because a Nansen instead of a Greenland sledge was used and because the dogs did not have a 350-mile journey behind them. Moreover, the route was first travelled downhill from the ice cap, since the glacier camp was established and the men and dogs arrived by air. But as in 1935 sledge loads had to be manhandled at the snout of the glacier. With the aid of Moore's photograph[3] taken from the summit, K. C. Arnold and G. Hattersley-Smith were able to identify Mount Oxford from a distance of about 9 miles.[4] Moore's "due north" for the direction of Mount Oxford

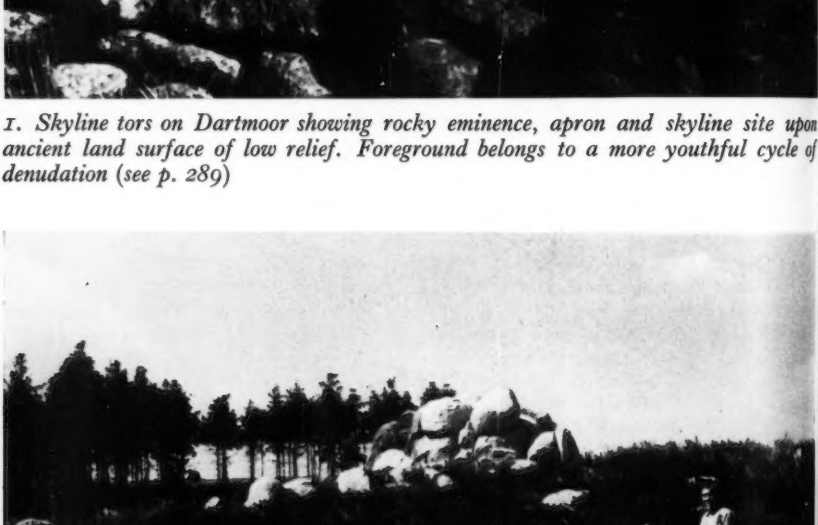
Above: View north-west from summit of Mount Oxford towards British Empire Range, 22 June 1957

Below: Mount Oxford and the highland ice of north-west Ellesmere Island from the east, 24 June 1950

Photograph: Royal Canadian Air Force



1. Skyline tors on Dartmoor showing rocky eminence, apron and skyline site upon ancient land surface of low relief. Foreground belongs to a more youthful cycle of denudation (*see p. 289*)



2. Sub-skyline tor in high Lozère, Central Plateau of France. Skyline of anciently planed landscape at higher level shows through trees. This tor (of the kind called "castle-koppies" in South Africa) lacks a pedimented apron and is part of the youthful, not the ancient, denudation cycle (*see p. 289*)

probably meant magnetic north, which is roughly true west. It is possible that in the field Moore was confused about direction by the available maps showing Gilman Glacier running north–south instead of north-west–south-east. These interpretations are more or less in accordance with the route plotted by Moore.[3]

Mount Oxford was climbed on 22 June 1957 and Moore's photograph was duplicated; the detail of rock and snow is almost identical in the two photographs. The height of the mountain was found to be 7200 feet by Wallace and Tiernan altimeter, or 1800 feet lower than Moore's estimate. Although the ascent of the peak in crampons was easy, it is not surprising that Moore remarked that—presumably in *kamiks*—"we had to exercise a full measure of care on the steep ridges of hard snow, and there was much laborious stepcutting." Arnold's observations with a Wild T2 theodolite gave the position of Mount Oxford as lat. 82° 09·6′ N., long. 72° 59′ W. The 1944 Canadian map shows the peak in position lat. 82° 27′ N., long. 71° 40′ W., which is due south of Cape Nares on the west side of Markham Bay. Owing to uncertainty of its position Mount Oxford was omitted from the most recent (1956) Canadian map of the area. The mountain is in fact almost due south of Cape Albert Edward, 12 miles west of Cape Nares. It seems probable that "the sea-ice in [Clements] Markham Inlet" seen by Moore was the ice shelf and off-lying pack ice at the mouth of Disraeli Fiord. The peaks of the British Empire Range, situated to the north-west between the heads of M'Clintock and Milne Fiords, are unlikely to exceed 9000 feet in height. Mount Oxford is a snow and ice peak. No cairn could have been built on the summit, nor was there any cairn on the slopes and ridges where rock is exposed below the summit. No trace of Moore and Nookapingwa was found along their route from Lake Hazen.

This note is published by permission of the Chairman, Defence Research Board of Canada.

G. HATTERSLEY-SMITH

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[1] Moore, A. W., "The sledge journey to Grant Land. Oxford University Ellesmere Land Expedition, III." *Geogr. J.* **87** (1936), pp. 419–27.

[2] E. A. A. S[hackleton], "Obituary: Arthur Winston Moore." *Geogr. J.* **89** (1937), p. 575.

[3] Shackleton, E. A. A., 'Arctic journeys: the story of the Oxford University Ellesmere Land Expedition, 1934–5.' London, 1937, 372 pp. [Plate facing p. 262; map at end.]

[4] Dunbar, Moira and K. R. Greenaway, 'Arctic Canada from the air.' Defence Research Board, Canada, 1956, 541 pp. [Fig. 382].

GEOLOGY IN AFRICA

In addition to the publications of the official geological surveys of the various African territories, much new work has been reported in the last few years at inter-territorial meetings. These have taken place under the auspices of the Association of African Geological Surveys, a sub-commission of the International Geological Congress, and the Regional Committees for Geology of the Commission for Technical Co-operation in Africa South of the Sahara (C.C.T.A.). Attention may be drawn to their publications which contain geological papers on a wide range of topics.

The Association of African Geological Surveys held a meeting at Nairobi in September 1954, and the "Compte-rendu et communications" were published in 1955 by the Bureau d'Études Géologiques et Minières Coloniales, Paris. Eleven papers are included dealing with pre-Cambrian correlations and with geochronology based on radioactive age determinations. The next meeting was held in Mexico on the occasion of the XXth International Geological Congress, 1956, at which a very wide range of subjects was discussed, but publication is still awaited. Three C.C.T.A. regional committees for geology have been set up to encourage the closer collaboration of the geological surveys of the member countries. The Southern Regional Committee met at Salisbury, Southern Rhodesia, in 1955, and the East Central Committee held its first meeting at Dar-es-Salaam in 1956. These two committees met again at Tananarive, Madagascar, in 1957. The record of the Dar-es-Salaam meeting was published under the sponsorship of C.C.T.A. in 1957. Some twenty-two papers are

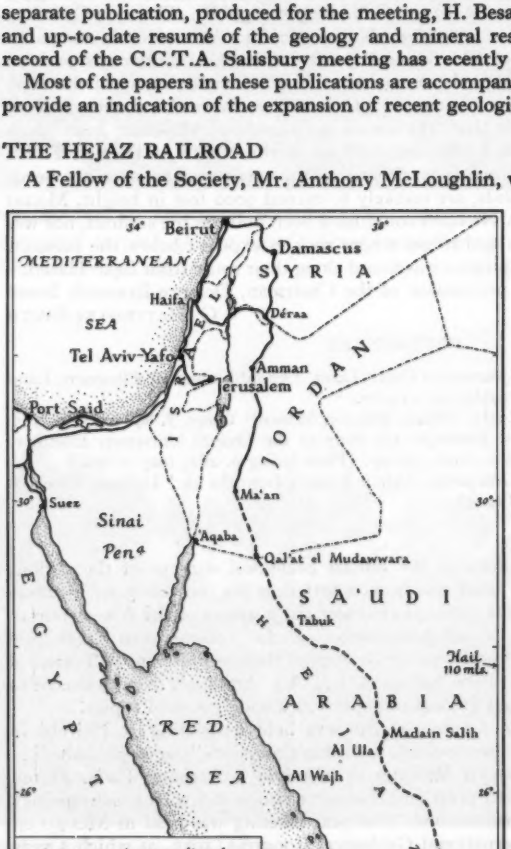
included under the following headings: Banded ironstones; Kalahari system—northward extensions; Relations and differentiation of the Karroo/Jurassic/Cretaceous; Rift Valleys and associated phenomena; and Distribution and variation in geological time of Primary Mineralization. The proceedings of the Tananarive Meeting have been roneo-typed by the Geological Survey of Madagascar. Twenty-seven papers are listed under the following subjects: The Mozambique Belt; Anorthosites; "Granites Stratoides," Pegmatites; Talc-schists and Soapstones; Correlation of sedimentary series of the Mozambique Channel; and Miscellaneous. Among the many useful papers on the geology of Madagascar, one by P. Cliquet is of special interest in describing aspects of the geological history of the Mozambique Channel based on the considerable amount of work carried out in the search for oil. In a separate publication, produced for the meeting, H. Besairie provides a most succinct and up-to-date resumé of the geology and mineral resources of Madagascar. The record of the C.C.T.A. Salisbury meeting has recently also appeared in print.

Most of the papers in these publications are accompanied by maps and the volumes provide an indication of the expansion of recent geological research in Africa.

J. W. PALLISTER

THE HEJAZ RAILROAD

A Fellow of the Society, Mr. Anthony McLoughlin, who returned from the Hejaz in the early part of 1957, has sent the following notes about the Hejaz Railroad for publication in the *Journal*. Mr. McLoughlin, who is a geologist, points out that the information in this note is strictly confined to 50 miles east and west of the railroad itself, but in view of the difficulty of gaining access to "Arabia Deserta" it may be of use to those who are unable to enter the territory and see for themselves.



"Along the north–south centre line of the Hejaz runs the disused railroad, built between the years 1901 and 1908 and rendered useless by T. E. Lawrence and his group in 1917. Perfectly constructed by the German Meismer Pasha, it was designed to carry pilgrims from Damascus to Mecca, but construction was not continued beyond Al Madinah. On one-metre gauge, with station buildings every twenty or thirty kilometres, it runs for 710 kilometres inside Arabia, often through the mountains. Today, long stretches of the embankment have succumbed to flash-floods and wind-blown sand, but in the main the line still exists. About a

quarter of the iron rails are completely corroded and evidence points to the sand blown from the salt-flats as being responsible for this. The existing road crosses and recrosses the line, and in all probability is the deciding feature as to which route the trail takes. In many places you drive alongside the rail for more than thirty kilometres, whereas in the hills you are forty kilometres distant. The stations were beautifully constructed of hewn stone, and many of them are 80 per cent. usable even now. During the First World War, in the time of the Arab Revolt, the buildings were garrisoned by Turkish soldiers and, indeed, the buildings are designed as forts, with firing steps, parapets and loopholes. Each one had a *birqi* or cistern, outside as well as within the walls, which was filled by *wagons-de-l'eau*. The railroad represents the principal man-made communication in the Hejaz. No real roads exist; a beaten track for motor vehicles is in evidence from Ma'an (Jordan) to Al Madinah, but four-by-four power wagons are essential. The track skirts the Hejaz railroad for most of this length and traverses many wadis, particularly the recurring Wadi Akhdar. At Mudawwara a lone sentry directs travellers to the frontier post lying tucked away in the hills some seven kilometres west of the existing railway station building.

From Mudawwara to Muadhanam (Mussam) you can average speeds of forty kilometres per hour along certain stretches, to the almost uncrossable jagged sandstone around Mutall and Al Hamra. Constant hard going through dry wadis creates major breakdowns, and I have actually seen three "Magirous Deutz" trucks all broken down with the same fault—collapsed rear axle—on the thirty kilometre stretch between Mudawwara and Dhatt al Hajj. Until one reaches Abu Tarqu there is no difficulty through sand drifts, but from Abu Tarqu to Al Ula you can run into dunes, or wide areas covered to a depth of twelve inches. In fact, the existing trail runs through the hills east of Mushaym (Mabrak an Naq'ah), and is so bad that even four-by-fours only just manage to get out of the sand, which is concentrated in the narrower passes. After Al Ula no difficulty is encountered and the road follows the centre-line of the wadi all the way to Al Madinah. Here, the Christian is left to his own devices as to how to by-pass the Holy City.

Some knowledge of the climate is of importance to the traveller in the Hejaz. Rain may occur on or about December 12, and one half-inch per day might be a good average until the beginning of January. For the remainder of the year there is no rain. Temperatures during the hottest months, usually July and August, can reach 140° F., during the day, but in the cooler season from September to December the highest recorded when I was there was 99° F. From sunset until dawn the air cools to 35° F. which often seems less when the suction creates night breezes. Three blankets are advisable for the Westerner. Few sandstorms occur except in the region around Hail, where wind-blown sand creates the impression of a major storm."

The fuller text on which the above note is based is available in the Library of the Society.

A CENSUS ANOMALY

The dangers of the frequented ways of the Census Returns have, in general, been adequately noticed and are by now fairly well-known, but a venture into marginal waters can still be enlivened by a subtly-concealed hazard. One such lies in the Census record of houses. Little use has ever been made of this body of material but the growing interest shown by geographers in the Census Return as an historical document may result sooner or later in a reconnaissance in this quarter and a cautionary note may not therefore be out of place.

The difficulties into which one sails are of the genre, not inconsiderable in the Census, "definition." It might seem at first sight that with a little ordinary care the numbers of occupied and unoccupied houses in a town, a parish, or a county, refined in particular ways, might be made to yield a useful group of indices: of the changes, for example, in the functions or importance of settlements; of prosperity or decline; and even, possibly, of regional migration in those decades in the early

nineteenth century for which the Census detail is incomplete. But when the attempt is made to understand the precise meaning to be attached to "house," as well as to "occupied" and "unoccupied," the complexities of the task become apparent. In the early Census Returns the difficulties are relatively slight and, what is more, they are fully discussed in the several "Reports" or "Observations" which accompanied them. In brief, it may be said that these argue the propriety of describing a block of flats as a single house, a problem which was, however, acute only in the context of the Scottish Census.

The first attempts at any definition came with the 1851 Census for which it was decided that a house was a dwelling "isolated and separated by party walls."[1] An alternative wording, which also appears to have been in use at the time, was "all the space within the external and party walls of a building,"[2] a rubric which may have originated in the instructions given to Enumerators in that year and which was subsequently adopted by the International Statistical Congress at its meeting in London in 1860. The outcome of the use of this definition was that the figures relating to housing published in the Census prior to 1911 included a wide variety of structures, a variety which will be familiar to those who have read the useful 'Guide to the Census Reports,' published in 1951: they range from "ordinary dwelling houses" to (among others) "blocks of shops with residences above"; "hotels, clubs, boarding-houses"; "institutions"; "warehouses, offices and business establishments (these only when inhabited by resident caretakers or others)."[3] To summarize, it may be said that all the usual buildings which people would normally live in are included, and even where business premises are admitted the obvious and important reservation is made, namely that there should be somebody dwelling there. On this evidence, therefore, one has no choice but to believe that a Census "house" was truly a habitation, and that the Census had consistently recorded dwelling-places only.

This being so, it is surprising to discover that at least as early as 1871 simple business premises were passing as houses in the enumeration. The Census of that year, for example (Report, p. xxx), commenting on uninhabited houses, reads ". . . the increase is probably due in great part to the increase in offices occupied during the day and left empty at night." Similarly in the 1881 Census we find (Report, Habitations, p. 14), ". . . of the houses reckoned as uninhabited, very many, especially in towns, were occupied in the daytime being used as offices or warehouses . . ." and it goes on to say that such occupation does not amount to habitation as there understood. The 1891 Census does not touch on the matter at all, but the 1901 Census is prepared to countenance even the lock-up shop, thus, "The increase . . . of uninhabited houses . . . was probably due . . . to an increase of 'Occupied' houses without inmates on the Census night, including 'lock-up' shops."[4] There is no explanation as to how such an entity could qualify within the accepted framework of definition but the clear implication is that the presence of residents was no longer being regarded as the criterion of a house.

There can be little doubt that this unexplained and imperfectly-dated departure from the declared practice is responsible for the numbers of "unoccupied houses" which abound in the central parts of towns: they are, for the most part, shops, offices and warehouses in use only in the daytime. Admittedly this conclusion is one which might have appeared "obvious" merely from an inspection of the proportions of unoccupied to occupied houses in towns and in country districts, but the point to be made is that such a conclusion would have been untenable in reference to the official Census description of the house which specified, consistently, residents. In brief, anomalous statements have appeared in successive Censuses: there has been in the definitive sections a stoutly-maintained assertion of "residence," whereas, else-

[1] Census, 1851. Report, p. xxxviii.
[2] Census, 1911. Vol. vi, "Buildings . . .", p. iii.
[3] The complete list is in Census 1911. Vol. vi, "Buildings . . ."
[4] Report, p. 36.

where, random remarks show that this had for long been a fiction. The fault is so uncharacteristic of the Reports as a whole that one concedes it with reluctance, but it is clearly a fact, and one which will doubtless be acknowledged at the proper time.

G. R. LUCAS

SOVIET GEOGRAPHICAL SERIALS IN THE SOCIETY'S LIBRARY

BULLETIN (IZVESTIYA) OF THE ACADEMY OF SCIENCES OF THE U.S.S.R. GEOGRAPHICAL SERIES, 1957: 5 (September–October). Administrative regions for the economy of the U.S.S.R., by P. M. Alampiyev. The present situation with regard to the scientific study of the natural resources of the U.S.S.R., by I. P. Gerasimov. Review of scientific reports at the coordination conference, by K. V. Dolgopolov and others. The oceans of the world and their natural resources, by V. G. Bogorov and others. Achievements and problems in the regional survey of physical geography in the U.S.S.R., by E. M. Murzayev. Achievements and problems in the regional survey of economic geography of the U.S.S.R., carried out by the Geographical Institute of the Academy of Sciences of the U.S.S.R., by S. N. Ryazantsev. The mapping of the U.S.S.R.: results and geographical importance, by K. A. Salishchev. Hydro-thermal regime on land surface and its importance to physical geography (four articles by I. P. Gerasimov and others). The history of Soviet geography, by A. A. Grigor'ev. A review of the scientific activities of the geographical institutions of the Academy of Sciences of the U.S.S.R. during the Soviet regime (five articles by L. G. Kamanin and others).

SAME SERIES: 6 (November–December). Some basic problems of physical geography, by A. A. Grigor'ev. The effectiveness of certain methods of thermal control, by S. M. Fotiyev. Phenomena peculiar to permafrost karst, by S. S. Korzhuyev and S. S. Nikolayev. The combat against line erosion on the left bank of the Don and its importance for the prevention of sand-silting in the Don and the Tsimlyanskiy reservoir, by V. A. Dubyanskiy. Geographical aspects of intercontinental air transport, by V. V. Pokshishevskiy. New glaciers in the Urals, by L. D. Dolgushin and A. O. Kemmerikh. An analysis of river flow factors and an assessment of their influence on industrial activity in the southern Volga region, by G. B. Nazarov. The part played by certain vertical zones in the formation of detritus, by A. V. Ermakov. High water silting in the river Kuro on 8 August 1955, by E. V. Ioganson. Changes in the longitudinal profiles of the affluents of lake Sevan in connection with the lowering of its level, by E. N. Bylinskiy. Flow in the upper Yenisei basin, by V. A. Stornyakov. Changes in the bird population in the north-eastern part of the Caspian as affected by fluctuations of the sea level, by V. S. Zaletayev. Assessment of evaporation and its ratio to irrigation, by L. P. Seryakova. Climatic regional divisions of the U.S.S.R., by B. P. Alisov. Methods for the economic zoning of the European People's Democracies, by N. F. Yanitskiy. Geographical science in the German Democratic Republic, by Kh. Zanke.

BULLETIN (IZVESTIYA) OF THE ALL-UNION GEOGRAPHICAL SOCIETY OF THE U.S.S.R., Vol. 89 (1957), No. 5 (September–October). A general glance at the development of some branches of geography in the U.S.S.R. during forty years of Soviet government, by S. V. Kalesnik. The development of landscape geography in the U.S.S.R. during the last forty years, by A. G. Isachenko. Soviet regional planning in the 40th anniversary of the Great October Socialist Revolution, by O. A. Konstantinov. New towns in the Uzbek S.S.R., by N. S. Ginzburg. Some basic problems in the teaching of regional physical geography in higher educational establishments, by V. I. Prokayev.

SAME SERIES: No. 6 (November–December). The continental shelf as a geographical zone of the Arctic Ocean, by Y. Y. Gakkel'. Contemporary glaciology in the Severnaya Zemlya Archipelago, by N. G. Zagorskaya. The history of old areas of irrigation in Khorezm, by B. V. Andrianov and others. Climatic conditions affecting vegetable cultivation in north-western European U.S.S.R., by I. A. Goltsberg. The ancient glaciation of the Tardoki-yani range (northern Sikhote-alin'), by E. N. Varfolomeyeva.

N. D. JENNINGS

NOTES

McGILL UNIVERSITY, MONTREAL, is considering the appointment of a senior geographer, at the rank of full professor. The authorities have in mind a man who is primarily interested in the human aspects of geography, and the appointment will be tenable at 1 September 1958 for a five-year period in the first instance. Full particulars may be obtained on writing to Professor F. Kenneth Hare, Geography Department, McGill University, Montreal.

* * *

VISA (No. 4, 1958), the magazine of the Cambridge University Explorers and Travellers Club, has just been received. Neatly produced with a lively cover, two maps and several photographs, the magazine contains accounts of recent Cambridge expeditions. There are articles on the Tibesti expedition, by Philip Johnson; the Colombian Cordillera Oriental expedition, by Peter Grubb; the Spitsbergen expedition, by P. F. Friend; and the South-east Iceland expedition, by G. R. Elliston, the editor of the magazine. All four ventures received grants from the R.G.S. There is also an account, by J. M. G. Davis, of "Hunting for honey-guides," the main activity of the French West African expedition approved by the R.G.S. An editorial note gives news of the club's continued popularity and expansion, and there are also articles on land development in Peru, and on modern Lahore.

* * *

The LE PLAY SOCIETY is organizing a summer visit (July 30–August 14) to Dürnstein in central Lower Austria, on the Danube. Dürnstein is a picturesque and historic town with many old customs surviving. It has a busy little port, and the hinterland offers an opportunity for making trans-humance and botanical studies. For further information write to Miss Margaret Tatton, The Birlings, Birling Gap, near Eastbourne.

* * *

The ORDNANCE SURVEY OF NORTHERN IRELAND has recently published a provisional edition of a new Quarter-Inch map of Northern Ireland (6*s* 6*d*, mounted and folded). The area fits conveniently on a single sheet. Emphasis has been placed on relief and communications: the relief, shown by layer-colours ranging from pale buff to a restrained brown, stands out clearly without killing other detail. Trunk and first class roads are in red. Names have been severely limited to the more important settlements and topographical features. Woods are in a solid, lightish, green without tree symbols. The result is an attractive, clear map, which will be appreciated by geographers and motorists.

* * *

Dr. I. B. F. Kormoss, of the Collège d'Europe, Bruges, has written a useful critical essay on European school atlases (ATLAS SCOLAIRES EUROPÉENS; Bruxelles, Commission Belge de Bibliographie, 1957). In it, he analyses in great detail the content, style and coverage of some forty atlases, including several British productions. He employs a high standard in judging them, as is seen in his conclusion which takes the form of a specification for an ideal school atlas. This requires relief to be shown by modern techniques—layer-colouring alone being rejected—at least 40 per cent. of the map area to be given to special maps (maps other than physical and political), and maps of social and cultural phenomena to be included.

* * *

Volumes 1 and 2 of THE INDIAN GEOGRAPHER have been received in the Library. The declared object of this journal of the Association of Indian Geographers is to "provide a forum for discussion on geographical problems," and, while welcoming the appearance of this new contribution to geographical literature, it must be said that in the present volume only two of the eight papers come up to the high standard desired. These are an evaluation by C. D. Deshpande of the reorganization of administrative divisions in India, and a short article by V. P. Subrahmanyam on thermal efficiency as an index of thermal continentality.

* * *

Applications are invited from candidates for appointment to the teaching staff of the Department of Geography, UNIVERSITY OF BAGHDAD for the academic year 1958–9. Candidates should have a basic degree in geography and a PH.D. in their field of specialization in geography. Applications giving full particulars of qualifications and of publications, if any, together with two recent photographs, should be forwarded to Professor Dr. A. A. Duri, Dean of College of Arts and Science, Baghdad, Iraq.

* * *

The Council of the Royal Anthropological Institute announces the HOCART MEMORIAL PRIZE for 1958 for the best essay on an anthropological subject, not exceeding 10,000 words in length, to be submitted by 31 October 1958. Only undergraduates or registered students working for a first degree, or a first post-graduate degree, in anthropology are eligible to compete, and essays must be submitted through the Head of the Department in which the competitor is working. Full particulars may be obtained from the Honorary Secretary, Royal Anthropological Institute, 21 Bedford Square, W.C.1.

* * *

OBITUARY

PROFESSOR LÉON WILLIAM COLLET

Professor Collet, who died at his home at Cologny, near Geneva, on 13 October 1957, at the age of seventy-eight years, had been an Honorary Member of the Society since 1923. He occupied the Chair of Geology and Palaeontology in the University of Geneva from 1918 to 1944. His chief interest was in Alpine tectonics, as evinced in his well-known book 'The structure of the Alps,' and other original geological publications including his paper read in 1926 to the Society on "The Alps and Wegener's Theory" (*Geogr. J.*, **67** (1926), p. 301); but he also maintained a strong interest in sundry aspects of physical geography. Not long after taking his doctorate (D.ès Sc.) at Geneva in 1904, Collet came to Scotland to work with the Murray-Pullar survey, under (later Sir) John Murray, on the freshwater lochs. At the same time his interest was aroused by the problems of the "new tectonics" of the north-west Highlands. Returning to Switzerland, he soon plunged into the limnological problems of his native lakes, and from 1912 to 1918 he was director of the newly founded Service de l'Hydrographie nationale suisse. An important joint work with R. Mellet and C. Ghezzi in 1918 was on 'Le lac Ritom,' and in due course appeared Collet's well-known book 'Les lacs' (1925); this latter had, however, been preceded by 'Les dépôts marins.' Moreover, to this Society he read in 1926 a much appreciated

paper on "The lakes of Scotland and of Switzerland," which enlisted keen discussion (*Geogr. J.*, 67 (1926), p. 193).

While Professor of Geology at Geneva he continued his researches on Alpine tectonics; and he generously and repeatedly entertained parties of British and American geologists, to whom he delighted to demonstrate the complex and often fantastic structures of the western Alps in particular. He could ramble and climb and carry with the best of them, for he declared that he was "born with a rucksack on my back!"

Collet was Visiting Professor of Alpine Geology at Harvard University from 1928 to 1929, during the present writer's appointment there; and apart from the immense impression made by his lectures, his keenness on sport and his interest in football (even the American version of the game) came as a surprise to all of us, for we had not realized previously that he had represented Switzerland at soccer against England!

In addition to the Honorary Membership bestowed by the Society, Collet was a Foreign Member of the Geological Society of London, an Honorary Fellow of the Royal Society of Edinburgh, and from Glasgow University he received the degree of LL.D.

N. E. ODELL

SIR ALEXANDER GIBB

Sir Alexander Gibb, G.B.E., C.B., F.R.S., the distinguished civil engineer who died on 22 January 1958, had been a Fellow of the Society since 1929. Sir Alexander Gibb was concerned in the construction both of the Rosyth Dockyard just before the First World War and of the Singapore Naval Base. He was at different times consulting engineer to the governments of Colombia and of Persia, technical adviser for public works and industrial development in Turkey, and in 1941 he was called in to advise on the new dock at Sydney. Sir Alexander's grandfather had trained under Telford, whose biography by Gibb himself was published in 1936.

PROFESSOR HERBERT KING

The death was announced in *The Times* of March 6 of Herbert King, Professor of Geography at Hull University. Professor King took his degree at Liverpool with First Class Honours in geography in 1922. He was one of the first members of the staff of the University College of Hull when it was founded in 1928, and played a principal part in building up the flourishing school of geography there of which he was the first head. He was the first Professor of Geography when a Chair was established at Hull in 1954.

CORRESPONDENCE

THE PROBLEM OF TORS

"Tor" was not, until recently, a scientifically defined term, but according to the Oxford dictionary was "a pointed, conical hill" or "rocky eminence." Usage finds most named tors in Devon, Cornwall and the Peak district of Derbyshire where small rocky hills sometimes occupy prominent positions in the landscape; but comparable features are found in many parts of the world.

Professor Linton's article in the *Geographical Journal*, 121 (1955), pp. 470–87, however, sought (p. 476) to ascribe a specific mode of origin by subsoil weathering and exhumation, and a restrictive definition, to tors that would render the term of scientific currency. This introduces difficulties, for not all tors originate under the tenets of Professor Linton's hypothesis. What, for instance, is one to call a prominent landmark that has been a named tor for centuries, but may not conform to Professor Linton's definition?

Briefly, tors are of two main types, *skyline tors* and *subskyline tors*.

Skyline tors (plate 1, facing p. 281) are small rocky hills occupying the highest points in the landscape. Under favourable circumstances they are circumscribed by smooth, outward-sloping aprons that close by the tor may visibly consist of planed bedrock. There is no difference of rock-composition between the tor and the apron and the boundary between them is an erosional boundary. Of necessity, such tors are invariably made of tough, resistant bedrock. In Africa the circumscribing rock aprons are pediments; though this origin is not always demonstrable in Britain where the skyline tors antedate the Ice Age and the original pediments have been modified by glacial and periglacial agencies, especially solifluction, so that some have lost the original concave profile of the pediment and become wholly or in part convex.

In terms of his hypothesis Linton assumes that these "basal platforms" represent "the position of the water table during the period of rock decomposition," but the platforms are too smooth and regular, and contrast too abruptly with the tors, to be related to such a fluctuating datum. Quite the contrary, all the features of skyline tors can be observed forming under surface drainage and mass movement, without deep weathering, in modern landscapes at an advanced stage of cyclic erosion, *e.g.* in Africa. Standing upon the skyline tors and surveying the surrounding countryside in Britain, one cannot seriously conceive of them as isolated residual cores within square miles of surrounding country of similar bedrock that is assumed to have been deeply weathered and removed.

Nor is joint spacing an adequate explanation for such postulated differential subsoil erosion. Even the degree of opening and weathering observed along the joints of tors may be a function of prolonged subaerial exposure rather than of subsoil spheroidal weathering, and the skyline tors are admittedly very old as landscape features.

The postulate of subsoil development and exhumation is thus unnecessary and redundant for the skyline tors, which are denudational residuals upon an old age land surface; and though they form the most typical and prominent examples of what by long usage have been called tors, they would have to be excluded from future application of the term if Professor Linton's genetic definition is accepted.

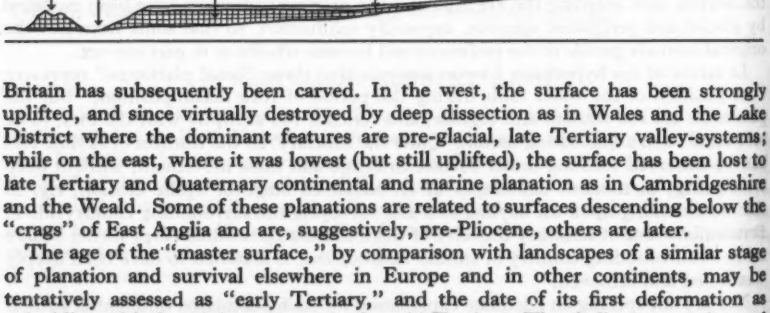
Subskyline tors (plate 2, facing p. 281) occur on valley sides and in depressions below the level of the ridge crests to which the skyline tors belong, and are part of a later cyclic denudation. They do not normally show circumscribing aprons nor are they usually part of a smoothly planed landscape such as is represented in the widely smoothed, tor-crowned upland or summit ridges of the earlier age. These are the tors that originate according to Professor Linton's hypothesis of subsoil weathering and exhumation. Indeed, all stages of the process as described in his paper may be

observed in the field. Examples are the tors on the northern flank of Dartmoor above Okehampton, and the granite tors of high Lozère on the Massif Central of France.

The genetic relation between the two sets of tors (see figure below) is thus as follows: the skyline tors are residuals (monadnocks) upon an ancient land surface of advanced planation (old age) such as may be observed in many parts of the world. The prolonged time required for the development of the tor-crowned plain (originally a pediplain), and perhaps its maintenance as a plain long after the smooth aspect was first attained, permitted deep subsurface weathering on suitably jointed rocks which formed the basic requirement for exhumation of subskyline tors when redissection of the landscape was induced under a second, newer cycle of erosion. As such, these tors are youthful features of a youthful landscape, the antithesis of the skyline tors.

The two types of tor, though utterly distinct in age and mode of origin are nevertheless related through the advanced erosional planation and weathering with which they are both, in different ways, associated. This is so in many countries that I have visited over five continents.

While, therefore, Professor Linton's map (his Fig. 3), showing the distribution of tors in Britain, does not discriminate between the two types of tor, it does indicate the distribution in Britain of remnants of a formerly widespread, senile, cyclic erosional land surface to which the tors are related. The distribution of tors upon many different rock types from the south-western counties through the Midlands into eastern Scotland is thus not fortuitous but defines the areas of survival in the modern landscape of an ancient "master" surface from which practically all the scenery of



Britain has subsequently been carved. In the west, the surface has been strongly uplifted, and since virtually destroyed by deep dissection as in Wales and the Lake District where the dominant features are pre-glacial, late Tertiary valley-systems; while on the east, where it was lowest (but still uplifted), the surface has been lost to late Tertiary and Quaternary continental and marine planation as in Cambridgeshire and the Weald. Some of these planations are related to surfaces descending below the "crags" of East Anglia and are, suggestively, pre-Pliocene, others are later.

The age of the "master surface," by comparison with landscapes of a similar stage of planation and survival elsewhere in Europe and in other continents, may be tentatively assessed as "early Tertiary," and the date of its first deformation as coinciding with the Alpine orogeny in the mid-Tertiary. The skyline tors, as integral parts of the ancient surface are thus probably early Tertiary survivals, and the subskyline tors of late Tertiary, or later, development. These conclusions imply that ice action on smooth upland regions during the Pleistocene has been of relatively minor importance, which is in accord with observations in other parts of the world (such as about Mount Monadnock on the New England plateau and on the Baraques of the Ardenne) where valleys have been deeply sculped by ice, producing oversteepened sides and trough ends, while the uplands were not sufficiently modified to remove even small pre-glacial residuals.

Professor Linton (p. 479), accepting some of the tors as pre-glacial in age, arrives at similar conclusions, and, noting the absence of tors from the heavily glaciated country of the west, opined "This is so because tors are part and parcel of an order of things which has been swept away from these areas by the heavy drubbing they received from the ice." Assigning a still earlier age to the "master surface" than Professor Linton does, I am inclined to think that most of the tors probably associated

with this surface in North Wales, the Lake District and the Western Highlands were destroyed under late Tertiary rejuvenation even before the glaciation set in.

LESTER KING

University of Natal,
Durban, South Africa

Professor D. L. Linton replies as follows:

I am very grateful to Professor Lester King for his interest in my observations on British tors. Though I believe there is much in common in our views, it may be helpful for discussion of the subject if I comment rather on the points on which we differ.

But first a word about the term "tor." This is both an English descriptive noun and a place-name element, derived from the OE *torr*, a loan word from the Cornish *tor*. Both as a common noun and as a place-name element it is used in two senses—to mean either a hill (as in Glastonbury Tor or in such village names as Torbryan and Dunster) or a rocky eminence (as in Haytor Rocks). A Derbyshire variant of the first usage applies it to a hill or lofty spur scarred by a rock face, as Mam Tor is scarred by its great landslip or Chee Tor and High Tor, Matlock, by their undercut river cliffs. The commonest place-name usage, as well as the commonest descriptive usage, is, however, for the rock features of the moors of Devon and Cornwall.

The use of any common noun as a technical term is always beset with the difficulty that the two usages will not coincide. A Spaniard does not restrict the word *cuesta* nor an Italian the word *tombolo* to the geomorphologists' special meanings: there are more hollows named *coire* in Highland Scotland than would be accepted as corries by a glaciologist. This must be accepted if we are not always to coin new words and make for ourselves a jargon that will hide our meaning from our fellow scientists: and to invent such a term for anything so well understood as the Dartmoor tors would have been quite gratuitous.

Professor King distinguishes between skyline and sub-skyline tors, and I have long found it convenient, with Mr. R. S. Waters and others, to make a similar distinction between ridge tors and valley-side tors. But instead of regarding them as "utterly distinct in age and mode of origin," I find that in Dartmoor, the Prescelly Hills, and the Cairngorms, there is no evidence of difference of origin but only of the date and degree of exhumation and later modification; the skyline tors were the earlier exhumed and have since been the more extensively modified by frost shattering, rain fretting and pitting, and solifluctive removal of loose core stones. Nothing in the British evidence that I have examined lends any support to Professor King's suggestion that "all the features of skyline tors can be observed forming under surface drainage and mass movement, without deep weathering, in modern landscapes." Oddly enough it is for a series of valley-side tors—the well-known Bridestones of north-east Yorkshire —that the best evidence has been adduced for the production of tor-like features by processes still in operation (J. Pilmer, "Tor formation at the Bridestones in N.E. Yorks," *Inst. Brit. Geogr. Trans. and Papers 1956*, pp. 55–71).

Possibly it is because Professor King's views about tors have been developed in more arid landscapes that he finds it difficult "to conceive of them as isolated residual cores within square miles of surrounding country of similar bedrock that it is assumed to have been deeply weathered and removed." Such deep rotting and removal has recently been well described for a humid tropical area of granite hills by B. P. Ruxton and L. Berry ("Weathering of granite and associated erosional features in Hong Kong," *Bull. Geol. Soc. Amer.*, 68 (1957), pp. 1263–1292). Wendelin Klaer in his study of granite weathering in Corsica (Verwitterungsformen im Granit auf Korsika, Ergänzungsheft 261 zu *Petermanns Mitteilungen*, Gotha, 1956, pp. 146) distinguishes between phanerogenic and kryptogenic origins for corestones and tors and concludes that the former are rare. It would be helpful if Professor King could provide detailed evidence of the sub-aerial evolution of some African castle kopje standing above its

pediment. Even where a British tor rises above a basal platform—as at Haytor Rocks—I would find it difficult to conceive that it had arrived at its present form by the centripetal retreat of its outward facing rock surfaces while the surrounding basal platform (Professor King's pediment) increased in area.

In the last paragraphs of his letter Professor King would associate all the tors on my map with a single widespread, senile "master surface" tentatively assessed as of early Tertiary age and "from which practically all the scenery of Britain has subsequently been carved." From this suggestion I must dissociate myself. Tors on the high Cairngorms (over 3700 feet) stand on hills that are themselves residuals above the Grampian Main Surface, a peneplain possibly as old as the "master surface" Professor King envisages. But I see no reason to believe that the tors are as old as this surface; there was ample time for the necessary deep weathering to have occurred while partial planation was being effected by rivers at lower levels in, say, Pliocene time. Tors are known at much lower altitudes not far away and there are records of deep weathering practically at sea level in the city of Aberdeen. Similar relations can be cited from Pembrokeshire though over a lesser range of altitude. The only surface that could be associated with all such occurrences is neither senile nor very ancient; it is the pre-glacial landscape produced by Pliocene erosion—well diversified as to relief but smooth and rounded as to forms, and everywhere mantled by a deeply rotted regolith.

DAVID L. LINTON

University of Sheffield
7 *April* 1958

DIFFERENTIAL WEATHERING OF OLDLANDS

Mr. R. S. Waters in his paper on "Differential weathering and erosion on oldlands" (*Geogr. J.*, **123** (1957), pp. 503–9) writes of the upland surface of Dartmoor above 1000 feet in the following terms: "The feature on Dartmoor was in no sense a plane surface, but rather an incomplete 'etchplain,' of the kind described by E. J. Wayland in Uganda (Wayland, 1934), which arose as a result of the differential lowering of a pre-existing fairly level surface whose unconsumed remnants exist only about the water partings on the northern and southern plateaus."

This appears to contain a use of the term "etchplain" which is at variance with its former connotation. Some consideration of the term may be useful lest the extension of its application go unnoticed. Wayland does not himself use the form "etchplain" in the reference cited.[1] He attributes the application of the term "etching" to Bailey Willis and applies it to suggest a process whereby, under tropical conditions of deep weathering—or rotting—and subsequent uplift, extensive plains might be inscribed in the surface of a pre-existing peneplain. Accordingly he writes of "etched plains"—and in one place "etched platforms." In his words these are "manifested as extensive plateaux"; "present an exceedingly flat surface"; and "are individualized by marked altitude differences." The two lower erosion surfaces which Wayland is here considering are extremely extensive in Uganda, being the surfaces referred to in a recent paper by Mr. J. W. Pallister in the *Journal* (*Geogr. J.*, **122** (1956), p. 80), in Wayland's own terms, as "Peneplain II" or the "Buganda Peneplain," and "Peneplain III." The Buganda peneplain, in particular, is evident throughout much of Buganda, and is the dominant feature of the landscapes of the Mengo District, an area of about 10,000 square miles. In a footnote on page 509 Mr. Waters speaks of the term etchplain being applied "to the less extensive platforms recognized by Wayland." There appears to be some misunderstanding here: there is a marked difference in the extensiveness of the features in Uganda and on Dartmoor which are compared.

[1] Wayland, E. J., "Peneplains and some other erosional platforms," *Ann. Rep. and Bull., Geol. Surv. Dept., Uganda, 1933*, Entebbe, 1934, pp. 77–9.

The "exceedingly flat surface" ascribed to the etched plains by Wayland is significant, since it is largely on this criterion that he separated them from the higher, undulating erosion surface, which he considered might represent a true peneplain. Mr. Waters describes the Dartmoor feature as being "in no sense a plane surface."

Professor King, in a review of Wayland's theory,[1] introduces the term "etchplain," reverting thereafter to the original and preferable description "etched plain." The chief agent in the formation of such features is held to be "deep and universal tropical weathering" with "the removal of this mantle of deeply weathered waste by laterally swinging rivers." The word universal in this context would appear to imply the absence of the selectivity of rotting, due to variations in jointing, which is postulated for Dartmoor. In fact, under the warm, humid climate of Uganda, granite surfaces may be lowered with remarkable uniformity; for example, the intruded granites of the "arenas" of Ankole.[2] Of the types of surface that may result from such uniform rotting and subsequent removal of waste King writes "characteristically they are wide, and poorly studded with monadnocks." Dartmoor, with its numerous tors, scarcely fits such a description. Although there are similarities between the rotting processes postulated by Mr. Waters and those described by Wayland, the latter, under the allied heat and humidity of a tropical environment, have operated much more thoroughly and less selectively.

The reference in Mr. Waters' paper to the behaviour of granites under tropical conditions is both timely and interesting. However, for reasons of scale, appearance, and the detailed operation of processes it would appear better to avoid the extension of the term etchplain to the features observed on Dartmoor.

D. N. McMaster

Makerere College, The University College of East Africa
3 *March* 1958

Mr. Waters replies:

I am grateful to Mr. McMaster for his comments on the use of the term "etchplain" which, as indicated in the footnote referred to, was applied by Professor King to surfaces recognized by E. J. Wayland. In spite of obvious differences of scale and appearance between the Uganda surfaces and the postulated mid-Tertiary surface on Dartmoor, the mode of origin of the latter would seem to be more precisely suggested by the genetic connotations of 'incomplete "etchplain"' than by those of other existing terms. It was felt that "etchplain"—in *inverted commas*—qualified by 'incomplete' would be acceptable. 'Incipient "etchplain" ' might be more appropriate.

R. S. Waters

Department of Geography,
University of Exeter
21 *April* 1958

LOCATION AND SPACE ECONOMY

The attitude adopted by your reviewer in the December 1957 issue of the *Geographical Journal* in his observations upon 'Location and the space economy' provokes a protest. Walter Isard set himself the task of providing "a modest attempt to depict and understand some of the basic spatial interrelationships which underlie the location of economic activities and regional development." Like much economic theory, the book seeks to provide a model, not accurately representing reality but generalized to further our understanding of it, and to gain "penetrating insights into the operation of economic processes in the real world." This is the prepared position of the economist: he may even take up the extreme stand of Lösch to declare that the question of

[1] King, L. C., "Landscape study in southern Africa," *Proc. Geol. Soc. S. Afr.*, 50 (1947), pp. xxvi–xxvii.

[2] Combe, A. D., "The geology of S.W. Ankole and adjacent territories, with special reference to the tin deposits," Geological Survey of Uganda, *Memoir no. 2*, Entebbe, 1932.

the best location is far more dignified than the determination of the actual one. Thus to complain that the theory breaks down the nearer it approaches reality is surely irrelevant, and a complete misunderstanding of the task which the economist has set himself.

The importance of this book to the student of economic geography should be stressed rather than mocked. The work which has been and is being done by the location economists is particularly important in the extension of our understanding, even though unfamiliarity with the economists' tools of substitution analysis and mathematics may present difficulties of comprehension at first reading: and one can not underline too frequently the need for the geographer to be aware of, and to appreciate, the work of others in allied fields of enquiry. Although Isard by no means offers a wholly satisfactory "General theory relating to industrial location, market areas, land use, trade and urban structure"—and the author, incidentally, readily admits to this charge in his preface, as well as stating his reservations with regards to general theories *per se*—it nevertheless progresses significantly towards such an end. The theory undoubtedly needs much more refinement both by economists and geographers, the one contributing from his more thorough understanding of production theory, and the other from his more empirical studies and observations. And perhaps a general heory, in the last resort, in an unattainable goal. But to laugh it off as a space game is as ill-advised as asking that Mr. Isard should become a hack translator of German texts.

GERALD MANNERS

Department of Geography,
University College of Swansea
7 February 1958

ARCTIC "VEGETATION ARCS"

The "vegetation arcs" discussed—and illustrated so graphically with striking air photographs—by W. A. Macfadyen [1] and J. E. G. W. Greenwood [2] in the Somaliland Protectorate have their counterparts in alpine and arctic environments. R. L. Ives [3] has described "staircase ponds" that may develop along poorly integrated drainage courses on sloping high altitude flats where the soil is thin and permafrost is present. The average height of one pond above the other, as given by Ives, is 8 inches. The "staircase ponds" form in areas of flowing water by the "armoring" of naturally created bars followed by the growth, on the bars, of dense grassy vegetation. The origin of the "vegetation arcs" as given by Greenwood is similar to that advanced by Ives for the "staircase ponds," the principal difference being in the more important role played by vegetation litter and excreta in the development of the "vegetation arcs."

The writer has seen patterns resembling the "staircase ponds" and "vegetation arcs" in tundra regions of the Western Canadian Arctic; specifically, in the area to the north and west of Great Bear Lake and on Cornwallis Island, District of Franklin. Similar vegetation patterns are observable on air photographs of other arctic areas, such as the Hudson Bay Coastal Plain.

The arctic patterns that were seen in the field were developed on fine-grained soils with slopes probably less than 10 degrees. The patterns were restricted to slopes that were maintained in a moist condition for much, if not all, of the summer season. Retention of moisture was aided by the underlying frozen ground which, in August, usually lay within 2 feet of the surface. The source of water was from seepage upslope; from the lateral dissipation of stream water over a broad area; from a melting

[1] Macfadyen, W. A., "Vegetation patterns in the semi-desert plains of British Somaliland," *Geogr. J.*, **116** (1950), pp. 199–211.

[2] Greenwood, J. E. G. W., "The development of vegetation patterns in Somaliland Protectorate," *Geogr. J.*, **123** (1957), pp. 465–73.

[3] Ives, R. L., "Tundra ponds," *Journal of Geomorphology*, **4** (1941), pp. 285–96.

snowbank and possibly ground ice; and in one instance from inundation caused by a rise in the level of a fresh water estuary at times of strong westerly onshore winds.

The arctic vegetation patterns apparently result from the growth of vegetation on large and small dikes or bars. The dikes tend to lie along the contour, in a pattern not unlike those of ricefields on terraced slopes, so the convexity or concavity of a dike system depends primarily upon the nature of the togography, whether on a ridge or valley slope. Dike heights range from several inches to over a foot; widths are normally several times the height; and lengths vary from a few feet to a possible several hundred feet. The vegetation on the dikes is composed of certain water-tolerant plants, principally sedges, mosses, grasses, and low willows. The origin of the dikes seems to be similar to that of the "staircase ponds." Possibly the winter expansion of ice in ponds dammed by the dikes may result in some lateral thrusting to help in the formation of the dikes.

It is interesting to note the resemblance in patterns among forms developed in such diverse environments as Somaliland Protectorate, alpine areas with permafrost, and the tundra of the Canadian Arctic. One might even carry the analogy one step further and draw attention to the superficial similarity of the above noted patterns with terraces resulting from mineral deposition in such well-known areas as Mammoth Hot Springs, Yellowstone Park, U.S.A.

These notes are based upon field-work done for the Geographical Branch, Ottawa.

J. Ross Mackay

Professor, Geography Division,
University of British Columbia,
Vancouver 8, *B.C., Canada*
13 *March* 1958

TRAINING OF CARTOGRAPHERS

On page 562 of the *Journal*, **122**, 4 (1957), Dr. Maling writes ". . . the more exacting work of map compilation . . . is essentially work for the graduate cartographer." I do not know what Dr. Maling's experience is in map production so I am unaware of his "yardstick." From my own experience I am quite sure he is wrong. Can he point to a single small scale map series in general use which has been compiled by graduates? Few, if any, sheets of the Carte Internationale du Monde, I.C.A.O., W.A.C., etc. 1 : 1 million series and none of the Ordnance Survey 10 Mile, Quarter Inch, One Inch, etc., series have been compiled by graduate cartographers. Does Dr. Maling seriously contend that the Society's cartographic staff is not competent to undertake map compilation for lack of University degrees? He would be hard put to it to find a graduate more competent for the job than those engaged on, *e.g.*, the Everest map.

We who are engaged on map production would welcome more graduates in our organisations, but not for use on compilation. The graduate's task is not the actual compilation which is, and should continue to be, done by cartographic draughtsmen who need experience of what detail can be shown at what scale and the ability to plot and fair draw the map.

Dr. Maling refers to a letter of mine in the *Journal*, **122**, 3 (1957) p. 403. It was not so much the ignorance of students but of graduates to which I was drawing attention and Dr. Maling's efforts to remedy this sad state of affairs can but be lauded.

He will not help, rather will he hinder his cause if he makes unfounded statements. In fairness to him it must be recorded that he is prepared to, and does, seek advice from the non-graduate cartographic staff of this Directorate.

W. C. D. Wiggins

Directorate of Overseas Survey,
Tolworth, Surrey
21 *April* 1958

LEWIS MORRIS (1701–65), SURVEYOR AND GEOGRAPHER

In his valuable paper on "Marine surveying in Britain during the seventeenth and eighteenth centuries" (*Geogr. J.*, **123** (1957), pp. 453–4), A. H. W. Robinson gives an interesting account of Lewis Morris's activities as marine surveyor. Is it correct to say, however, that his survey was begun near the Great Orme Head? Morris gives the date of commencement as 4 July 1737, without specifying his starting-point.[1] There is evidence, on the other hand, to suggest that he set to work not at Great Orme, but at Holyhead. This is in the form of a small pocket-book of 200 pages kept at the National Library of Wales, Aberystwyth (N.L.W. MS. 607A); written on the spine is its title: "Welsh Coast. Survey Notes. Lewis Morris MS. 8." Here, by means of the record of his bearings, soundings and descriptive notes or sketches, it is possible to follow Lewis Morris as he progressed south-eastwards from Holyhead, along the western coast of Anglesey, in the summer of 1737.

On July 19 he was at Llangwyfan, roughly half-way along the coastline from Holy Island to the Menai Strait; there he found "Sea Cabage in plenty which ye Inhabitants say are Excellent Sproutd for Eating" (p. 32). He had drawn a cromlech at Llanfaelog, and went on to Tywyn Aberffraw and some of its ancient sites; at Malldraeth (then a much larger inlet) he noted a vein of coal. Morris made some interesting observations about the blown sand of Newborough Warren, which had been troublesome since at least 1568[2]: "In former times ye Sands was blown from Llanddwyn, and almost buried ye Town. Impoverished ye Inhabitants, yt. they sold their Charter or gave it up. Sr. A. Owen hath ordered ye Street in Several places, and found a pavement about 1 foot deep . . . No. of Housekeepers, 9 . . . Manufactures, sedges or Bent Ropes & Mats. the Best Flooks, Cockles, Base & Mullet in Malldraeth . . . a place where there are ruins of Houses, now Coverd with Sand mostly. Some few good patches of ground. High Sand banks" (p. 131 *et seq.*). Again, at Llanddwyn Island, he wrote: "From llanddwyn neck, almost thro' towds. abermenai the W. Wind hath blown on high tides ye Sea thro." Finally he reached Caernarvon Bar: "a dangerous Stone off here a mile from shore discoverd lately by Carnarvon men."

On August 5, just one month after beginning the survey, Morris was at Caernarvon itself. There he continued his readings and soundings along the shores of the mainland—apparently to the south, away from the Menai Strait toward Dinas Dinlle, which he sketched. Morris's notes, briefly quoted from this one field-book, also reveal his wider interests. Even a casual glance through his published letters will show that he was more than a marine and land surveyor. His versatility as mining engineer and naturalist, antiquary, linguist, and farmer, is rather bewildering. More particularly, Lewis Morris had a good knowledge of geography and cartography; he collected and interpreted many different kinds of natural and historical evidence. His concern with natural history in its widest contemporary sense, his plan for writing a description of Anglesey—one special result of his successful surveying—together with other ventures, all serve to bring him to the geographer's notice. The present writer hopes to discuss these facets of Morris's work in his contribution to a forthcoming commemorative volume on Edward Lhwyd (1660–1709), who inspired many of them.

F. V. EMERY

School of Geography,
Oxford
31 *March* 1958

[1] Owen, H. (ed.), "Additional letters of the Morrises of Anglesey," *Y Cymmrodor*, 49, 1 (1947) p. 95.

[2] Steers, J. A., 'The coastline of England and Wales,' 1946, p. 118. Newborough, etc., can be made out on Fig. 3 in Mr. Robinson's paper.

MEETINGS: SESSION 1957–8

Meeting of 3 February 1958. The President in the Chair

Paper: The ancient landscape of southern Etruria. By John Ward Perkins, C.B.E.

Elections to Fellowship: G. E. D. Alcock; M. R. Al-fell; T. W. F. Allan; G. Arnold; Rev. K. Appasamy; D. A. Atkinson; P. F. F. Banyard; Wing Commander E. B. Beauman; Thomas Boak; F. D. Bottomley; S. W. Brookes; George H. Curtis; L. G. Davies; V. D. Dennison; Miss L. V. Dollar; Miss M. Ferra; Hugh J. Gibb; J. A. Hague; P. H. Harris; Miss F. E. Harvey; R. Hindson; F. Holland; F. A. Khan; O. V. O. Macaulay; R. M. Maclean; G. L. Maxwell; A. Mondiwa; Duncan Moore; D. B. Naunton; J. G. B. Newbould; R. Newland; Paul N. Okafor; Robert Ollerton; A. L. Oluwole; C. A. Parker; R. Mansell Prothero; R. S. Rodgers; Dr. F. C. Schwarz; Major F. L. Scott; R. A. G. Self; A. P. Shuhla; Miss A. S. Stainsforth; D. B. Stevens; B. E. Stokes; K. J. Syrett; S. H. Tadaw; L. E. Tanner; Miss O. Tchernine; F. G. Vosburgh; Mrs. M. H. H. Webb; Miss B. B. Williams; H. J. Williams; Miss J. E. B. Winbolt

Elections to Associate Membership: G. W. P. Cosserat; D. W. Hughes; Miss B. Moir; B. P. Moody; Miss J. A. R. Moore; B. H. A. Ranson; M. E. Symes; C. J. Trimmer; Miss R. Tringham; A. M. O'Connor; G. P. N. Williams

Meeting of 10 February 1958. Mr Leonard Brooks in the Chair

Film: The last cannibals. By Jens Bjerre

Meeting of 17 February 1958. Major-General R. Ll. Brown in the Chair

Paper: Surveying and the modern expedition. By A. Stephenson, O.B.E.

Meeting of 24 February 1958. The President in the Chair

Paper: The Imperial College Karakoram expedition. By Eric Shipton, C.B.E.

Elections to Fellowship: Basil Ainsley; C. G. N. Birks; Mrs. V. Cusack; C. Embleton; R. H. Fairclough; Miss M. F. Frost; Mrs. L. Glasse; E. A. Green; A. E. Gregory; R. W. Holberton; Warren C. Hultgren; Henry Johnson; M. S. Khaladkar; R. P. Kirby; Miss K. Mann; O. Osifo; Ung Cheng Pee; J. R. V. Prescott; L. J. Smith; Donald H. Tarling; James A. Taylor

Elections to Associate Membership: David Broome; Miss Anne Edis; B. J. S. Karalus; J. W. McDermott; Miss J. M. Roberts; R. L. Scott

Meeting of 3 March 1958. Mr. Leonard Brooks in the Chair

Film: Cities of the Amazon. By J. E. Grant White

Meeting of 10 March 1958. The President in the Chair

Paper: Rock magnetism as evidence of continental drift. By Professor P. M. S. Blackett, F.R.S.

Elections to Fellowship: Mrs. J. M. Allan; Gerald Andrew; Donald G. Bayliss; Rev. William Black; Professor E. G. Bowen; Alan Braithwaite; Aubrey Buller; Alan G. Challis; Richard J. Chorley, M.A.; John Doody; Lieutenant-Colonel P. J. L. Drewe; Miss M. Hamar; John K. Hartley; Martin W. Holdgate; James Hooper, B.SC.; Mrs. S. A. James, B.A.; W. A. McCutcheon; Leonard S. Morris, B.SC.; Edward J. Maguire; R. S. de Sant Mortlock; D. J. Moss; Richard G. Oliver; B. O. C. Onwuteaka; Mark J. Parry, B.SC.; Colin N. Peters; Miss M. Poslethwaite; David G. W. Pugh; F. J. Raine, M.A.; Leonard Richards; E. A. Redwood-Sawyerr; Miss P. Barclay-Smith; A. G. Stone; W. P. G. Thomson; Bernard W. Vaughan; W. T. Walker

Elections to Associate Membership: Roger A. Brickell; T. M. Butterfield; J. L. Davidson; Miss S. J. Munday; G. Q. Stanbridge

Meeting of 24 March 1958. Professor L. Dudley Stamp in the Chair

Paper: A water use survey. By Professor W. G. V. Balchin

Meeting of 31 March 1958. The President in the Chair

Paper: The enigma of Easter Island. By Thor Heyerdahl

Elections to Fellowship: Mrs. Joy Eastgate; Colonel J. M. Fain; Dr. L. G. Gebb; H. E. Vum Ko Hau; M. J. Jackman; Charles McCarthy; Rev. Robert McMillan; A. J. Mahabirsingh; D. V. Miles, B.A.; J. F. Parkinson; Miss Jean Pattison, B.SC.; A. W. Spackman; Henry D. Talbot; Richard Young

Elections to Associate Membership: Ian Gibb; Miss D. G. Powell; Michael B. Rice

Meeting of 14 April 1958. Mr. Leonard Brooks in the Chair

Film: Overland to Singapore. By A. C. Barrington Brown